1. INTRODUCTION

The Townsend-Winona Road (TW Rd) Corridor Study (Project) was initiated by the Coconino County Public Works Department (CCPW) and Flagstaff Metropolitan Planning Organization (FMPO). In this section, the purpose and need for the Project is outlined, an executive summary and the public involvement summary are provided.

1.1 Purpose and Need

The purpose of the TW Rd Corridor Study is to determine the future infrastructure needs to provide for the safe and efficient movement of people and goods along the TW Rd Corridor and Leupp Rd. This study also considers the movement of people and goods between the TW Rd Corridor and the area south and west toward the City Limits of Flagstaff; in the vicinity of Route 66, Country Club Dr and I-40. The need for improvements will be determined by travel demand, accident history, agency needs and public input.

Based on the data and evaluation, 2-lanes will be sufficient to provide adequate capacity along TW Rd and Leupp Rd through the year 2030. The capacity for a two lane roadway will only be sufficient with the use of a continuous center left turn lane and right turn lanes. Wider shoulders and the addition of a path are also needed the meet the multi-model operational and safety needs of the existing corridors.

The data and evaluation also show a need for a new north-south corridor. The only viable concept generally extends US 89 south from TW Rd, along the east side of Sheep Hill to a southerly terminus at I-40.

1.2 Executive Summary

Based on the definitions for the thresholds for roadway improvements described in *Section 3.3*, the need for improvements along TW Rd are met in the western reaches of TW Rd today. Per the year 2030 travel demand forecast, the evaluation in *Sections 4.1 & 4.4* shows that continued improvements along TW Rd and Leupp Rd will be needed throughout the study horizon. As described in *Sections 4.2 & 4.3*, the improvements warranted along TW Rd and Leupp Rd includes the use of a continuous center left turn lane, right turn lanes and the suggested use of modern roundabout intersections at six of the main intersections along TW Rd.

Access management strategies such as the limited use of raised medians (for the approach to roundabout intersections), eliminating driveways for a length of 150' on all approaches to intersections, frontage roads and joint access agreements are tools that should be implemented in areas where it is reasonable to do so as outlined in *Section 4.5*.

The safety for those using school bus stops and mail box pullouts should be enhanced with the use of more spacious designs as shown in *Section 4.6*. These improvements will also allow for more capacity along the mainline of TW Rd and Leupp Rd.

In general the improvements recommended to meet the future needs of the Project Corridors can be met within the existing right-of-way. The primary exception will be to accommodate the modern roundabout. As described in *Section 4.7*, a 50' triangle will be required in all 4-quadrants of the typical 4-leg intersection to accommodate their use. In addition slivers of right-of-way may be needed in areas where the existing roadway is high enough or low enough relative to the natural ground elevation at the right-of-way line where the proposed cut and fill limits dictate. The use of retaining wall, curb and gutter, guard rail and barriers are options to right-of-way acquisition that should be considered during the next design phase in the project planning process.

Travel demand forecast data provided by the FMPO shows that a new corridor, called the West Alternative Corridor in this study, that extends US 89 south from its intersection with TW Rd to a new traffic interchange (TI) with I-40 is warranted and desirable, see *Section 6.1*. In addition to volume warrants; with the recent exchange of what was US 89 in the area of the Flagstaff Mall with the City of Flagstaff, the Arizona Department of Transportation no longer has a route they maintain for regional traffic to connect to I-40 and US 89 north of TW Rd. Based on these factors, the addition of West Alternative Corridor to the FMPO long range plan is recommended. Additional details for local streets, access and circulation are defined in *Section 6.3*.

Paths are recommended as a part of the improvements along TW Rd and Leupp Rd, per *Sections 7.2 & 7.3*. To achieve the maximum benefit, other existing and proposed local and regional paths in the area should be linked with the path proposed along the Project Corridor to form an inter-linked system of paths.

1.3 Preferred Project Plans

The plan for the preferred alternatives as selected by public and agencies is shown immediately following report text.

1.4 Public Involvement

A public meeting was provided on Wednesday March 5, 2008 at the Christensen Grade School in Flagstaff between the hours of 6:00 and 8:00 PM. Copies of the media notice, post card that were circulated by the County; along with a copy of the handout/questionnaire and the exhibit boards provided by Civiltec as shown on pages **A-18** to **A-26** in the appendices. One-hundred two people signed in. Others joined in the meeting, but declined to sign in.

The following information was gathered for TW Rd based on conversations: narrow shoulders, too much truck traffic, narrow road, speeding, lane striping, not enough turn lanes, not enough paths.

The following information was gathered for the West Alternative Corridor based on conversations: negative impact on Picture Canyon, negative impact on adjacent homes, lower property values, disturbs wildlife, and negative impact to the environment in general.

The responses to the questionnaire that was provided are as follows:

- ... Are the traffic forecasts reasonable? . . . . . Yes – 9
  No – 5
- Are the 4 TW Rd alternatives reasonable? . . . . . Yes – 15
  No – 3
- Which alternative is preferred? . . . . . Alt 1 – 3 Alt 2 - 6
  Alt 3 – 12 Alt 4 - 1
- Which alternative is least preferred? . . . Alt 1 – 3 Alt 2 - 0
  Alt 3 – 1 Alt 4 - 10
- Do you support roundabouts? . . . . . Yes – 9
  No – 7
- Do you support an Alternative Corridor? . . . . . West – 12
  East – 8
  No – 10
- Do you support access control? . . . . . Yes – 14
  No – 1
- Do you support raised medians . . . . . Yes – 4
  No - 10

To protect the privacy of the individuals, the sign-in sheets and comment sheets are not included in this report. They have been provided to CCPW and FMPO under separate cover.

2. EXISTING AND KNOWN FUTURE POLICY ENVIRONMENT

In this section the existing and known future policy environment is described. These elements form the basis for the study. These policies are provided by Coconino County (County), the City of Flagstaff (City), the local neighborhood group known as the Doney Park Timberline Fernwood Area, the Arizona Department of Transportation (ADOT) and various national standards and guidelines for roadway, transit, and pedestrian design, safety and operations.

2.1 General Policy Environment

The existing policy environment is shaped by the existing community plans and jurisdictional agency policies and standards. The Coconino County Comprehensive Plan, Doney Park Timberline Fernwood Area Plan, Coconino County Standards, City of Flagstaff Standards, the ADOT Standards, American Association of State Highway and Transportation Officials (AASHTO) *Policy on Geometric Design of Highways and Streets (Green Book)*, and *Highway Capacity Manual* (*HCM*) operational criteria were reviewed and used for the basis of evaluating the existing and proposed future corridor roadway. The Coconino County plan and local area plans emphasize the following:

- Safe roadway network.
- Regional transit service.
- Multimodal facilities.
- Trail access to neighborhood and national forest.

The following was taken directly from the Coconino County Comprehensive Plan and the Doney Park Timberline Fernwood Area Plan.

2.1.1 Coconino County Comprehensive Plan. The following are visions that affect the corridor:

- Existing communities accommodate growth while retaining their historic and culture charter.
- Collaborative planning insures success in addressing issue across jurisdictional lines.
- Residents are assured a variety of transportation choices and modes.

The following are goals that affect the corridor:

- Maintain a circulation network that is safe efficient and complementary to local communities and the environment.
- Improve rural and regional transit service opportunities
- Improve non-motorized circulation networks and provide greater opportunity for alternate modes of travel
- Support a regional system of trails that link communities, public lands, and activity centers.
- Ensure the quality design and development of circulation systems
- Improve and maintain circulation infrastructure while protecting the environment and community character
- Provide for safe travel and access to property.

The following are policies that affect the corridor:

- As communities continue to develop and populations increase the County supports opportunities to enhance and expand local regional and inter jurisdictional transit services.
- Consideration should be given to providing public transit access or sites for future transit infrastructure development in the review of major developments and subdivisions.
- The County encourages developments projects to provide infrastructure for non-motorized travel, and when appropriate for new developments along major roadways, shall require the installation of trails and bicycle lanes.
- In coordination with ADOT, the Forest Service, and land managers and owners, the County promotes the connection of existing neighborhoods and communities (at both a local and regional scale) with trails, non-motorized, and multimodal facilities.
- Multimodal and non-motorized travel facilities should be designed to complement and enhance local community character and provide opportunities for interaction among residents.
- Where pedestrian and bicycle routes exist on adjacent properties, major developments and subdivisions must maintain connections and continue the cohesive development of the non-motorized circulation network.
- The County shall set an example of incorporating pedestrian and bicycle travel infrastructure into the redevelopment or new construction of County collector and arterial roadways, and supports efforts to incorporate non-motorized facilities into state highway redevelopment projects.
- Before considering capacity improvements, the County encourages the preservation, improvement, and (where appropriate) redevelopment or restoration of existing circulation infrastructure.
- The County promotes the development of multimodal and public transit opportunities as preferred alternatives to new roadway capacity improvements along highly traveled and congested travel corridors.
- To protect unique natural areas and preserve wildlife habitat and movement areas, the County encourages creative design of circulation infrastructure improvement projects
- Private property owners are encouraged to meet minimum County standards for rights-of-way when private easements are created.
- The County promotes safety improvement and maintenance projects for circulation infrastructure (including snow and ice removal) which are consistent with conservation and ecosystem protection.
- To ensure the safe an efficient flow of traffic, the County encourages the use of access management techniques to increase safety and supports development of public transit facilities and service in areas of high vehicle congestion.
- Where not addressed through the CIP, major developments and subdivisions shall pay for necessary circulation improvements to support access to and within the site.
- To provide adequate access for emergency service vehicles, circulation infrastructure in major developments, subdivisions, and other residential neighborhoods must provide connectivity to adjacent existing and potential future infrastructure.
- The County will work with developers to improve safety and circulation efficiency for pedestrians and bicyclists when adjacent roadway improvement or property development occurs.
- The County supports a comprehensive approach to addressing the need for public lands access, continuity of trail networks, provisions for non-motorized circulation, and resource protection through community trails plans.
- To protect sensitive natural and cultural resources, the County encourages the identification and development of trails designed to accommodate a high level of use while minimizing impacts to the environment.
- Development projects must consider and plan for public land access and the design and maintenance of proposed trails, trailheads, and bicycle lanes that meet County guidelines.
- In coordination with developers, community groups, and land management agencies, the County encourages regional planning of non-motorized circulation infrastructure and facilities, such as trails and bike lanes that link destination areas, community activity centers, and where appropriate designated access points to public lands.
- Partnerships are encouraged among the County, trail managers, trail users, and neighborhoods to improve trail safety and access, user information, volunteer stewardship, linkages between long-distance trails, and recognition of historic trails.

2.1.2 Doney Park Timberline Fernwood Area Plan. The Doney Park Timberline Fernwood Area Plan states that current trends (1996-2000) indicate an average of 72 new homes and 43 mobile homes have been added each year with an estimated build out between 2015 and 2020. The estimated population of the area in 2000 was 7979 in

2300 single family and 1100 mobile homes. This produces an average of 2.4 people per dwelling. The following are additional excerpts that provide context:

- 2/3 of Doney Park Timberline Fernwood planning area is national forest.
- It is estimated that as many as 1,000 people use the Cinder Hills off road vehicle (OHV) recreation area.
- The Plan recommends fixed route public transit systems when feasible.
- Traffic conflicts involving vehicles and pedestrians or bicycles are a concern due to lack of adequate shoulders or off road trail facilities.
- There are forest service areas in Doney Park Timberline Fernwood area designated as low priority for retention indicating they may be available for exchange.
- The Flagstaff area regional land use and transportation plan has set these forest areas outside the rural growth boundaries.

The following are the goals and policies that affect the corridor:

- Signs should be placed at sites of wild life usage to minimize wild life kills.
- The County shall post county roads to restrict unlicensed OHV use. Rigorous enforcement laws shall be pursued.
- New residential subdivisions adjacent to national forest lands shall be required to provide trail easements to the forest.
- Native vegetation is protected and preserved signage and fencing of new commercial developments or redevelopments shall be aesthetically compatible with the rural, meadow, and forest character of the community and natural environment.
- Access to planned regional developments (PRD) with gross densities higher than one per 2 ½ acres shall be directly from arterials (e.g. Townsend Winona Road) or collectors.
- Developers of new subdivisions shall be required to fund and provide for any required infrastructure improvements both on and off site and not cause any undue financial burden on existing area residents or the County.
- New commercial developments requiring commercial zoning shall be located at the six commercial rural activity centers including Slayton/Lumberjack at the intersection of Townsend Winona Road and Slayton Ranch Road and Lumberjack Boulevard, and Winona located on the north side of the interstate at the interchange.
- The Plan specifically outlines a policy to provide trail along the Rio de Flag and a non-motorized/pedestrian/bicycle/equestrian trail along Townsend Winona Road.

The following are Transportation Committee Recommendations for the area:

- The establishment of a priority collector roadway system.
- Mechanisms for the improvement of local roads.
- Mass transit possibilities.
- Non-Vehicle transportation.
- Existing policies and road way standards and consideration of land use changes and their effect on the roadway system.

Encroachment permits are required by Coconino Public Works Department for any activity within county right of ways. The County is urged to provide a safe and efficient collector roadway system which incorporates safe trail systems and utility corridors. County roadways in the area include the following:

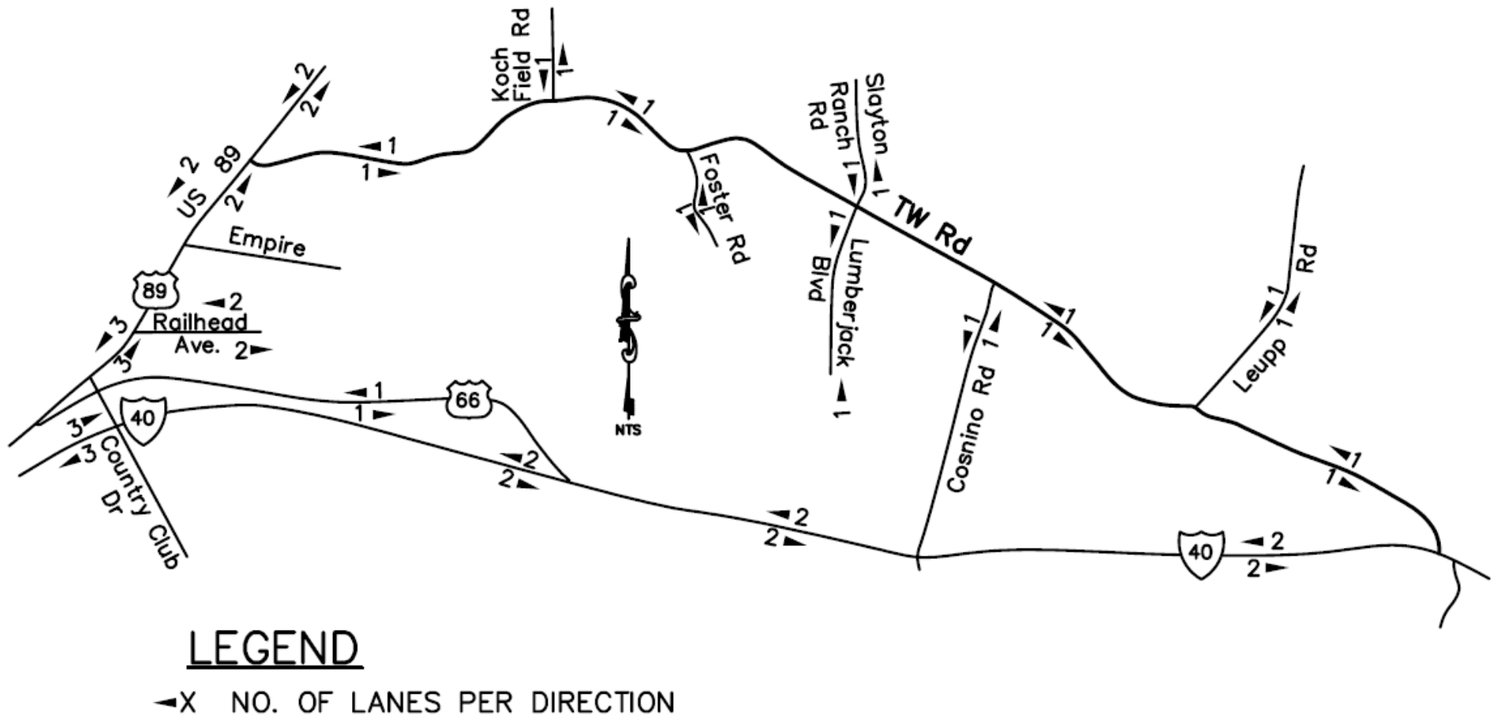


Figure 2.1

YEAR 2007 & 2030 FMPO MODEL
BASE–NUMBER OF LANES

- Leupp Rd — Major collector
- TW Rd — Minor arterial
- Koch Field Rd — Major collector
- Silver Saddle Rd — Major collector
- Cosnino Rd — Minor collector
- Campbell Ave — Minor collector
- Copeland Ln — Minor collector
- Burris Ln — Minor collector

2.1.3. FMPO Existing and Year 2030 Long Range Plan Roadway Network. Figure 2.1 shows the roadway network in the study area; with the basic number of lanes know to be in place in the year 2007 and used in the FYMPO model for the year 2030. Development levels for 2030 are based on the Flagstaff Area Regional Land Use and Transportation Plan and developed in consultation with Coconino County.

2.1.4 State Lands and USFS Lands – Development Potential. **Table 2.1** shows the township, range and sections (T-R-S) of land that has the potential to become developed at some time in the future. *Section 3.5* contains a map to reference these locations. In order to test the ability of any recommended improvements to handle unexpected growth the model was loaded with a worse case scenario. In this scenario, an additional 3,859 homes and the trips they generate were added to the model. These are described in **Table 2.1** below. The additional trips did not create the need for more additional capacity.

Table 2.1
Potential Future State and USFS Lands Development

Description (T – R – S)	Owner	Area (Acres)	Percent Developed	Density (Unit/Ac)	Total Units
City of Flagstaff					
21 – 8 – 4	State	517	60	4	1240
21 – 8 – 4	State	27	80	4	87
21 – 8 – 10	State	320	50	5.2	832
21 – 8 – 10	State	256	50	7	896
21 – 8 – 3	USFS	320	100	.2	64
Coconino County					
21 – 8 – 2	USFS	640	50	0.2	64
21 – 9 – 5	USFS	270	100	0.2	54
21 – 9 – 6	USFS	190	100	0.2	38
21 – 9 – 7	USFS	560	100	0.2	112
21 – 9 – 8	USFS	310	100	0.2	62
21 – 9 – 14	USFS	70	100	0.2	14
21 – 9 – 14	USFS	170	100	0.4	68
21 – 9 – 18	USFS	115	100	0.4	46
22 – 8 – 32	USFS	258	100	0.4	103
22 – 8 – 35	USFS	560	100	0.2	112
22 – 8 – 36	USFS	190	100	0.2	38
22 – 8 – 36	USFS	140	100	0.2	28
Total Number of Units					**3859**

2.2 Design Standards

This section will outline the design standards that will apply to the various corridors being studied.

- County
- Flagstaff
- ADOT – AASHTO

2.2.1. Coconino County Standards. The following roadway classifications require the right-of-way, bike and pedestrian as outlined below:

- Minor collector road with no curb and gutter 80 foot right of way with two 8 foot bike and pedestrian paths,
- Major collector road with no curb and gutter 100 foot right of way with two 8 foot bike and pedestrian paths.
- Major collector road with no curb and gutter 100 foot right of way with two 5 foot paved bike lanes and two 5 foot pedestrian paths.
- Minor arterial road with curb and gutter 120 foot right of way with two 6 foot paved bike lanes and one 8 foot pedestrian paths.

2.2.2. City of Flagstaff Standards. None of the existing streets being studied and no known future streets being planned at this time are within the City of Flagstaff's jurisdiction. If this changes, the current standards for the appropriate street classification should be provided at the time the final planning or preliminary design are done.

2.2.3. ADOT and AASHTO Standards. None of the existing streets being studied at this time are within ADOTs jurisdiction. If this changes, the current standards for the appropriate street classification should be provided at the time the final planning or preliminary design are done.

2.2.4. HCM Operational Criteria. A posted speed limit of 50 miles per hour (mph) or less is provided for all the existing roadway segments in this study. This speed limit is consistent with a 2-lane rural road with numerous driveway and street intersections. Therefore, for the mainline a level of service (LOS) C or better is desired for TW Rd; however CCPW has said a LOS D or better is acceptable for TW Rd and Leupp Rd. At all intersections a LOS D or better is desired.

If during the course of this study facilities that will be owned and operated by ADOT are considered, additional consideration will be provided accordingly.

3. TW RD & LEUPP RD CORRIDORS - EXISTING CONDITIONS

The ADOT Traffic HES Section prepared a *Roadway Safety Audit for Townsend-Winona Road, US 89 to I-40*, dated May 8-10, 2007. A copy of this report is provided on pages **A-1** to **A-8** in the **appendices**. Pages 11 thru 14 from the *Roadway Safety Audit* contain the recommendations.

To access the horizontal alignment and cross-sectional elements, as-built plan data as shown in **Table 3.1**, will be compared to the current standards.

Table 3.1
Asbuilt Plans

Project No.	Agency	Milepost	Description
S-394(1)	ADOT	420.7 – 429.1	TW Rd - Original design plans
04-REC-02	County	420.7 – 420.9	US 89/TW Rd intersection reconstruction
No Plans	N/A	429.1 – 430.0	TW Rd - See r/w strip map for horizontal alignment
BRS-394(2)P	County	430.0 – 430.6	TW Rd – Realignment & Walnut Creek Bridge
No Plans	N/A	430.6 – 430.8	TW Rd - See r/w strip map for horizontal alignment
07058.12	County	430.8 – 431.4	TW Rd – Realignment & Railroad Overpass
S-419(1)	ADOT	N/A	Leupp Rd – Original design plans

Understanding the sufficiency of the existing corridors will include an analysis of the alignment, cross-sectional elements, right-of-way (R/W), traffic and accident history. The alignment analysis will consider both the horizontal and vertical geometry. The cross-sectional analysis will consider the roadway widths, shoulder widths and fore-slope grades. The R/W analysis will document widths along the study corridors and obstacles within the area. The R/W analysis will also show the types of land owners adjacent to the corridors, be it private, Arizona State Lands, United States National Forest (USNF), etc. Traffic counts have been collected along the study corridors. A planning level of analysis will be provided to document the operations. Accident data has also been collected to determine if there are any high accident locations where geometry or cross-sectional elements may be contributing.

CCPW has asked that TW Rd be assessed using a 55 mile per hour (mph) design speed. Two exceptions were made, one for the approach to US 89 and the second for the approach to I-40. The approach to US 89 was assessed at a 25 mph speed limit because TW Rd comes to a dead-end and must stop, then turn left or right. The approach to I-40 was assessed at a 35 mph speed limit because TW Rd comes to the ramp intersections at the I-40 interchange, then dead-ends.

Due to the gaps in the as-built plans, there are two or more vertical curves that we do not have data on. It appears the two gaps fall along tangent sections of road. When design quality mapping is obtained in the future, the gap areas should be assessed to assure there is no deficiencies in the geometry.

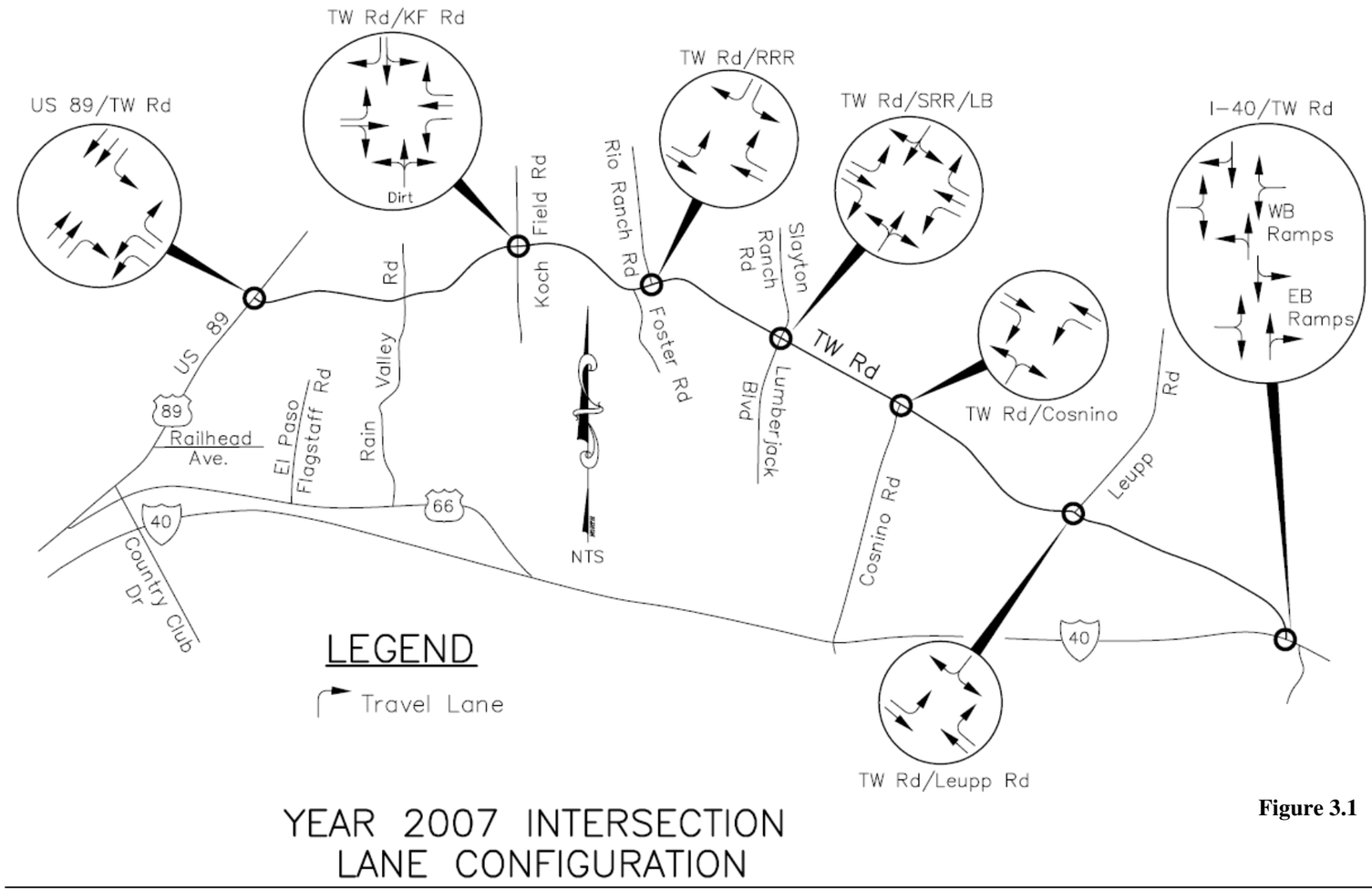
CCPW has asked that Leupp Rd be assessed using a 40 mph design speed. One exception was made for the approach to TW Rd. This approach was assessed at a 25 mph speed limit because Leupp Rd comes to a dead-end and must come to a stop, then turn either left or right to continue.

3.1 Horizontal Alignment

The sufficiency of the horizontal alignments were evaluated by comparing the existing curve radii to the maximum radii provided by the *Green Book*, by the AASHTO, 2001. The controlling radii were obtained from ***Exhibit 3-22*** from the *Green Book* for a super-elevation rate of 6%. For TW Rd the minimum acceptable radii are 1,065' for a design speed of 55 mph, 380' for a design speed of 35 mph and 185' for a design speed of 25 mph.

There are 17 horizontal curves along TW Rd to be examined using a 55 mph design speed. Of the 17 curves, only the 4th curve at PI Station (Sta) 89+53.12 has a radii that is less then 1,065'. The radius at this location is 954.93'. Per the *Green Book* a radii of 954.93' provides a design speed of 52± mph. Both the radii approaching US 89 and I-40 exceed the minimum requirement.

For Leupp Rd the minimum acceptable radii are 510' for a design speed of 40 mph and 185' for a design speed of 25 mph. There is 1 horizontal curve along the section of TW Rd and it is in the 40 mph design speed area. This curve exceeds the minimum requirement.



YEAR 2007 INTERSECTION LANE CONFIGURATION

Figure 3.1

3.1.1 Intersection Geometry. The existing lane configuration shown on **Figure 3.1** illustrates the location where existing left and right turn lanes are provided.

TW Rd is a curvilinear alignment. The driveways for private parcels along TW Rd are generally aligned perpendicular to TW Rd. The intersecting roads along TW Rd are in general oriented in either a north-south or east-west direction. As a result, there are numerous road intersections that are skewed. Per the *Green Book*, an intersection that is skewed more the 30-degrees from perpendicular should be realigned to remove some of the skew. **Table 3.2** provides a list of intersections whose skew exceeds AASHTO's recommended criteria.

Table 3.2
Skewed Intersections

Mile Post	Road
422.5	Hidden Hills Rd/ Pine Canyon Dr
424.2	Foster Rd
425.8	Lumberjack Blvd
426.1	Dusty Trail
426.3	Brinkman Dr
426.4	Unnamed Private Road
427.2	Cracked Pot Dr
427.3	Bluefield Rd
427.5	Wildflower Rd
427.7	Velvet Valley Ln
428.7	Leupp Rd
429.5	Parsons Ranch Rd
429.7	Copley Dr
429.9	Bridge Dr
430.0	Duck Dr
430.1	Wade Ln
430.2	Durango Way
430.3	3-Unnamed Private Drives
430.3	4 Winds Dr
Leupp Rd	Rustler Rd
Leupp Rd	Wrangler Rd
Leupp Rd	Prospector Trail/Mine View

3.2 Vertical Alignment

The vertical alignment was assessed using a program provided by ADOT, as shown below; which is based on criteria established by AASHTO. The TW Rd as-built plans provided 39-vertical curves. Of these curves, two do not provide the stopping sight distance (SSD) for the controlling design speed. The first is at PI Sta 83+75 and the second is at PI Sta 115+00. The first location provides a SSD for a 50 mph design speed and is a sag curve. The second provides a SSD for a 52 mph design speed and is a crest curve.

The Leupp Rd as-built plans provided 3-vertical curves, as shown below. These curves provide SSD for the controlling design speed.

Townsend - Winona Rd
US 89 to I-40
ATTACHMENT 1 - VERTICAL CURVE INVENTORY

Project Name: Townsend Winona Rd Corridor Study
Project Number: Not Assigned
Roadway Type: 2-Lane Rural - Major Collector Road

VPI STATION	MILEPOST BEGIN	MILEPOST END	TRAFFIC DIRECTION (1w, 1a or 2)	GRADE IN (%)	GRADE OUT (%)	CURVE LENGTH (ft)	CURVE TYPE	STOPPING SIGHT DISTANCE AVAILABLE (ft)	STOPPING SIGHT DISTANCE AASHTO MINIMUM (ft)	SPEED AVAILABLE (mph)	SPEED DESIGN (mph)
1+50			2	-1.7650	-6.4900	100	Crest	278	166	35	25
9+10			2	-6.0000	-4.5000	500	Sag	+9999	552	+100	55
24+30.			2	-4.5000	-2.9900	500	Sag	+9999	535	+100	55
42+00			2	-2.9900	-4.7000	550	Crest	906	537	75	55
47+25			2	-4.7000	-2.1900	500	Sag	1089	537	84	55
74+30			2	-2.1900	-4.4900	500	Crest	719	535	66	55
83+75			2	-4.4900	2.5500	750	Sag	465 *	535	50	55
92+00			2	2.5500	0.0820	500	Crest	687	515	66	55
103+00			2	0.0820	0.1000	600	Sag	+9999	493	+100	55
113+00			2	0.1000	-1.1800	500	Crest	1093	502	88	55
127+00			2	-1.1800	0.7623	800	Sag	5080	502	+100	55
139+50			2	0.7623	2.1500	500	Sag	+9999	511	+100	55
151+50			2	2.1500	-0.6700	600	Crest	683	511	66	55
176+70			2	-0.6700	-5.0500	1800	Crest	942	541	77	55
189+60			2	-5.0500	-2.7300	500	Sag	1368	541	+100	55
204+00			2	-2.7300	1.7500	600	Sag	564	517	58	55
213+50			2	1.7500	-3.0000	800	Crest	603	519	60	55
223+50			2	-3.0000	-0.2220	500	Sag	870	519	75	55
231+50			2	-0.2220	-2.6000	500	Crest	704	515	67	55
242+50			2	-2.6000	-1.9000	500	Sag	+9999	515	+100	55
263+00			2	-1.9000	-4.5000	700	Crest	765	535	68	55
271+00			2	-4.5000	-1.1120	800	Sag	949	535	78	55
294+80			2	-1.1120	-2.7470	700	Crest	1010	517	82	55
312+60			2	-1.1800	0.2480	600	Sag	+9999	502	+100	55
324+00			2	0.2480	1.7500	500	Sag	+9999	507	+100	55
329+75			2	1.7500	-0.2400	650	Crest	867	507	76	55
357+00			2	-0.2400	1.2000	650	Sag	+9999	502	+100	55
364+50			2	1.2000	-1.4300	850	Crest	835	504	75	55
371+50			2	-1.4300	-0.1500	500	Sag	+9999	504	+100	55
387+25			2	-0.1500	-2.5000	500	Crest	709	514	67	55
395+50			2	-2.5000	-0.3600	1150	Sag	3668	514	+100	55
406+00			2	-0.3600	1.3500	500	Sag	+9999	504	+100	55
413+00			2	1.3500	-1.1200	800	Crest	837	504	75	55
435+75			2	-1.1200	-2.6100	800	Crest	1124	516	88	55
63+00			2	-0.9343	-0.2500	600	Sag	+9999	500	+100	55
107+50			2	3.2800	4.7880	200	Sag	+9999	538	+100	55
115+00			2	4.7880	0.3700	500	Crest	494 *	538	52	55
124+75			2	0.3700	5.0000	300	Sag	311	266	39	35
Leupp Rd											
7+00			2	0.8600	-1.5000	600	Crest	757	154	71	25
17+00			2	-1.5000	-2.5500	400	Crest	1228	375	93	45
32+50			2	-2.5500	1.0300	400	Sag	501	375	54	45

Notes:
Traffic Direction:
1w = One Way Traffic in Station direction
1a = One Way Traffic against Station direction
2 = Two Way Traffic

Grades are with respect to Station direction.
* Indicates design exception required.
GB indicates grade break. Stopping Sight Distance and Speed not calculated.
Calculations are based on AASHTO 2001 and ADOT 2004 Roadway Design Guidelines formulas with adjustments for effective grade.

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3.3 Traffic

Traffic Research and Analysis provided traffic count data; see pages **TD-1** to **TD-9** in the appendices, to both the FMPO and Civiltec through separate contracts for this project. The counts were obtained during July, 2007. The counts were collected for a minimum of 48-hours. In general the machine tube counts and manual turning movement counts were reasonable close to matching. The data was manually adjusted so that the highest volume on an approach, identified by either the tube counts or manual counts were used. This forced the data presented in the tube counts and turning movement counts to coincide. **Figure 3.2** shows the summary of the Year 2007 Tube Counts and **Figure 3.3** shows the summary of the Year 2007 Turning Movement Counts.

Evaluation of Existing Basic Lane Traffic. First, a planning level threshold must be established to effectively evaluate the traffic volume data along the basic roadways. The *HCM* is the document used by all agencies for guidance in evaluating delay and LOS. Based on the *HCM* the Maricopa County Department of Transportation (MCDOT) established **Table 3.3** for planning purposes on their facilities. Note the roadway classifications used in **Table 3.3** does not match those used by Coconino County. CCPW agreed that the Maricopa County "Rural - Major Collector" standard was the best match for Coconino County's minor arterial designation for TW Rd.

Additional guidance was needed from CCPW to help define how to use **Table 3.3**. The key information collected from the CCPW was the acceptable LOS for the TW Rd and Leupp Rd corridors before additional thru lanes or turn lanes were needed. CCPW stated that a LOS D was acceptable before additional thru lanes would be required. Finally, engineering judgment was used to finalize the threshold volumes used in this study to determine the need for thru lanes and turn lanes. The following calculations show how the various threshold planning level volumes were selected:

Table 3.3

MCDOT Roadway Design Manual

Urban Roadway Level of Service and Service Volumes							
Road Classification	**Desired LOS**	**ADT/ Lane**	**No. Thru Lanes**	**2-Way ADT Range**	**Pk.Hr./ ADT %**	**Max. Pk. Hr. Ln. Vol.**	***Max. Rdwy. Length**
Local	A	350	2	50 -700	15	60	1,000 ft.
Minor Collector	B	2,500	2	500 - 5,000	12	360	1/2 mi.
Major Collector	C	3,500	2	600 - 7,000	10	420	2 mi.
Minor Arterial	C	5,500	4	6,000 - 22,000	8	530	---
Principal Arterial	D	7,500	6	18,000 - 45,000	8	720	---
Rural Roadway Level of Service and Service Volumes							
Road Classification	**Desired LOS**	**ADT/ Lane**	**No. Thru Lanes**	**2-Way ADT Range**	**Pk.Hr./ ADT %**	**Max. Pk. Hr. Ln. Vol.**	**Max. Rdwy. Length**
Local	A	500	2	50 - 1,000	15	90	1 mi.
Minor Collector	B	3,000	2	800 - 6,000	12	430	2 mi.
Major Collector	B	4,000	2	1,000 - 8,000	10	480	---
Minor Arterial	C	9,000	4	6,000 - 36,000	10	1,100	---
Principal Arterial	C	10,000	4	10,000 - 40,000	10	1,200	---

(Note: MCDOT Standards for minor collectors and major collectors are 2-lane and 3-lane respectively.)

<u>*Threshold 1 => 2-Lane Section With No Left Turn Lane.*</u> A LOS B threshold is recommended for the 2-lane section. The primary reason for recommending a LOS B threshold suggested is the desire to manage the risk for motorists to pass a slow moving or right turning vehicle. Nearly as important is the impact left turning vehicles have on slowing thru traffic. Those in attendance at the Public Meeting indicated there is a strong desire to pass slow moving or right turning vehicles along the Project; and there are frequent left turn maneuvers that cause motorists to slow to a crawl speed or stop. Given the limitation for passing and bypass left turning vehicles on the existing 2-lane section on TW Rd and Leupp Rd; there are very few opportunities to pass which causes frequent slowing and stopping. Accident history in general shows that a strong demand to pass, slow down or stop; coupled with limited opportunities to pass produces a dangerous condition. Therefore, the recommended threshold volume to be used the 2-lane section in this Study is 6,000 vehicles per day (vpd), which correlates to a LOS B for a Rural Roadway.

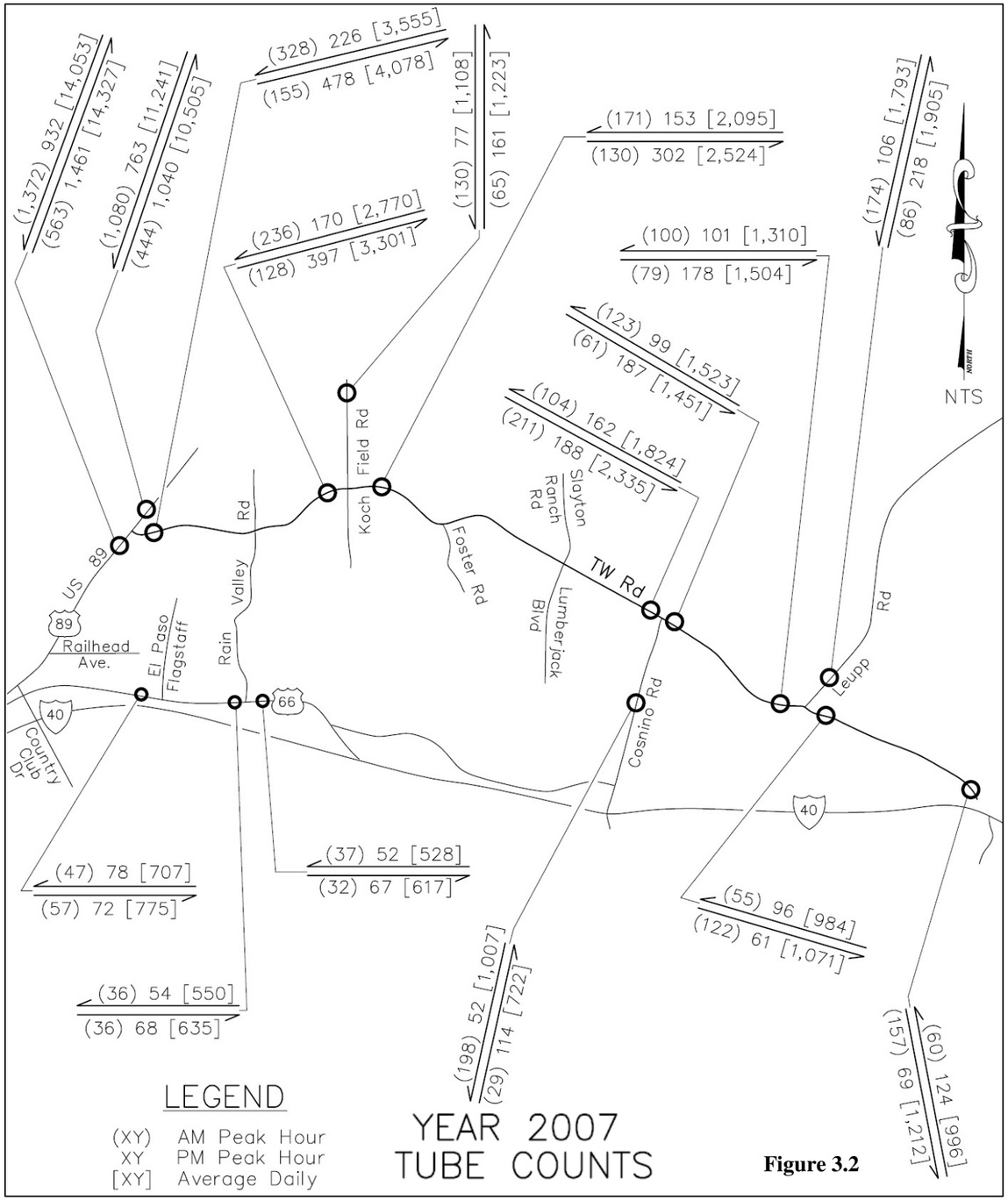


Figure 3.2

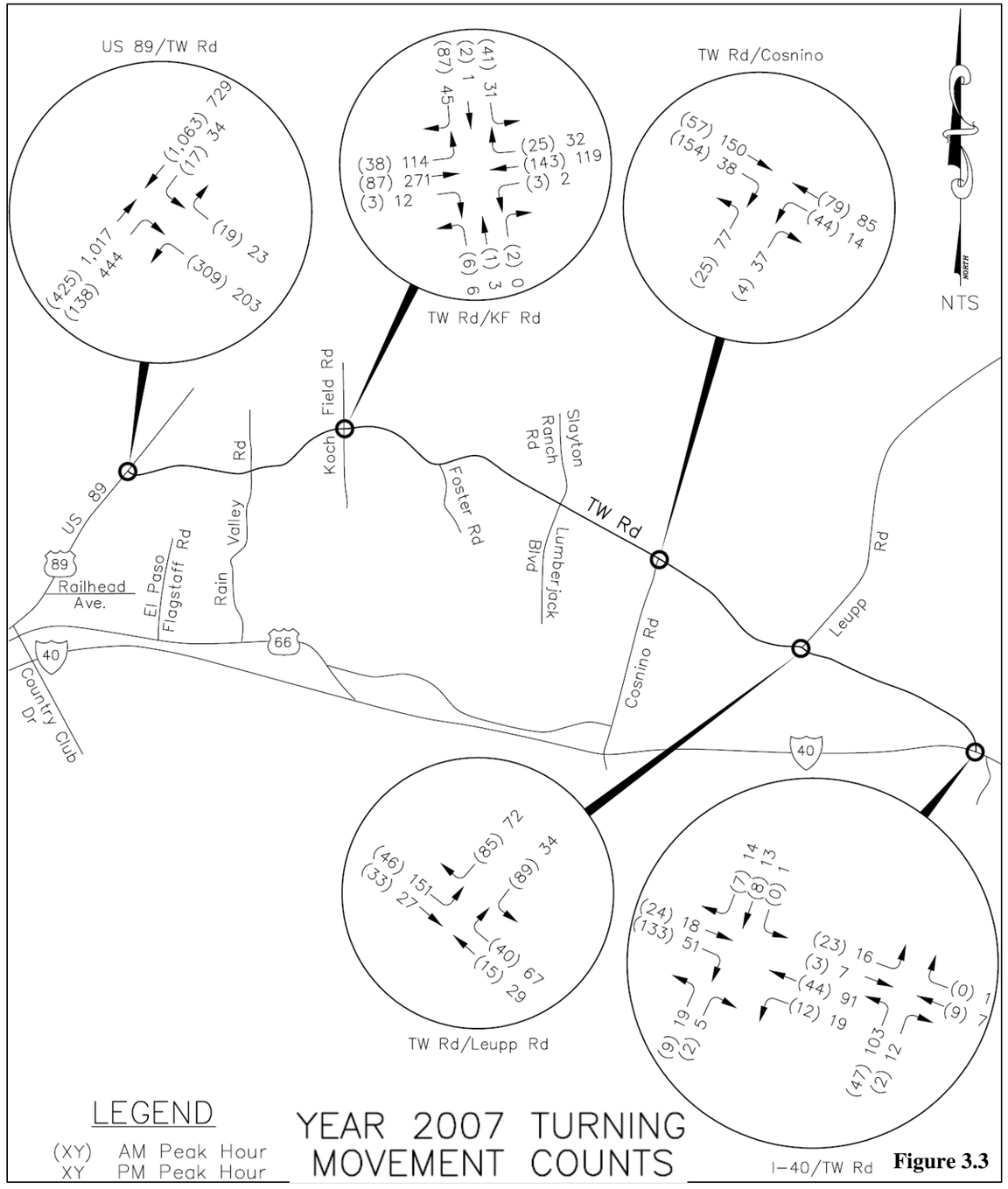


Figure 3.3

Threshold 2 => 3-Lane Section With A Limited Use of Right Turn Lanes. A differentiation is made for the 3-lane section with a limited use of right turn lanes and an extensive use of right turn lanes. This approach is tied to a motorist desire to maintain their speed rather then slow down for right turning vehicles. In the case where limited right turn lanes are provided, a LOS C threshold is recommended for the 3-lane section. Therefore, the recommended threshold volume to be used the 3-lane section with a limited use of right turn lanes 9,000 vpd. This volume threshold was reached based on an approximation of reasonable capacity per **Table 3.3**; tough it not an exact fit with any of the conditions presented in the **Table 3.3**.

The limited use of right turn lanes is defined as any driveway or street intersection that has 30 or more right turn movements in a peak hour. Assuming a design speed of 50 mph, these right turn lanes must have minimum total length of at least (120' of length for deceleration plus a minimum of 25' of queuing length for the first 30 movements per hour) 145'. Once the right turn volume exceeds 44 vph, each increment of 15 additional vehicles above the threshold volume of 30 vph should be accommodated by an additional 25' of queuing length. For example, a right turn lane that is projected to handle 63 right turn movements in the peak hour should have [120' + 25' + (25' * 2 – because 63 is over 2-increments of 15 above the baseline of 30 vph)] 195'.

Threshold 3 => 3-Lane Section With An Extensive Use of Right Turn Lanes. A 3-lane section with an extensive use of right turn lanes should eliminate most conflicts with right turn movements; therefore, it can carry more traffic then the 3-lane section with a limited use of right turn lanes. In the case where the extensive use of a right turn lane is provided, the LOS D threshold approved by CCPW is acceptable for the 3-lane section. Therefore, the recommended threshold volume to be used the 3-lane section with the extensive use of right turn lanes is 13,500 vpd. This volume threshold was reached based on an approximation of reasonable capacity per **Table 3.3**; though it not an exact fit with any of the conditions presented in the **Table 3.3**.

The extensive use of right turn lanes is defined as any driveway or street intersection that has 10 or more turn movements in a peak hour. Assuming a design speed of 50 mph, these right turn lanes must have minimum total length of at least (120' of length for deceleration plus a minimum of 25' of queuing length for the first 10 movements per hour) 145'. Once the right turn volume exceeds 24 vph, each increment of 15 additional vehicles above the threshold volume of 10 vph should be accommodated by an additional 25' of queuing length. For example, a right turn lane that is projected to handle 48 right turn movements in the peak hour should have [120' + 25' + (25' * 2 – because 48 is over 2-increments of 15 above the baseline of 10 vph)] 195'.

Evaluation of Intersection Traffic. In addition to basic lane operations and safety, the intersection operation and safety was evaluated. The data provided in **Figure 3.3** shows the volumes for the US 89, Koch Field Rd (KF Rd), Cosnino Rd, Leupp Rd and I-40 ramp intersections. Since the intersection of US 89/TW Rd was recently reconstructed to provide a 2nd westbound (WB) to southbound (SB) left turn lane and other improvements; no analysis of this intersection is provided. To ensure that the TW Rd, Cosnino Rd and Leupp Rd intersections are functioning at an acceptable LOS, they were analyzed using the *HCM Analysis Software (HCS)*, provided by McTrans with the approval of the Federal Highway Administration (FHWA). **Table 3.4** summarizes the results of the analysis. Pages **A-9 to A-11** shows the detailed results. All the movements will operate at a LOS B or better except the NB approach along Koch Field Rd in the PM peak hour. The analysis shows the SB approach will operate at a LOS C. Note the very small volumes making this movement.

Table 3.4
TW Rd Unsignalized Intersection Analysis
Year 2007

Intersection			A.M. Peak			P.M. Peak		
			vph	Delay	LOS	vph	Delay	LOS
TW Rd / Koch Field Rd	EB	Lt	38	7.6	A	114	7.8	A
	WB	Lt	3	7.4	A	2	7.9	A
	NB	Lt/Th/Rt	6 / 1 / 0	11.6	B	6 / 3 / 0	16.9	C
	SB	Lt/Th/Rt	41 / 2 / 87	10.8	B	31 / 1 / 45	13.1	B
TW Rd / Cosnino Rd	WB	Lt	44	7.8	A	14	7.6	A
	NB	Lt/Th/Rt	25 / 0 / 4	10.0-	A	77 / 0 / 37	10.7	B
TW Rd / Leupp Rd	EB	Lt	46	7.4	A	151	7.7	A
	SB	Lt/Th/Rt	89 / 0 / 85	9.9	A	34 / 0 / 92	10.1	B

Conclusions for Existing Traffic. The section of TW Rd between US 89 and Koch Field Rd currently cares over 6,000 vpd. Therefore, it is recommended that a continuous center left turn lane (3-lane typical section) be provided to remove left turn movements from the thru lanes along this section of TW Rd. The balance of the system along TW Rd and Leupp Rd is adequate to carry the existing traffic volumes.

The need for right turn lanes with the appropriate deceleration length was considered for the section of TW Rd between US 89 and Koch Field Rd because the thru volumes exceed 6,000 vpd. Per the turn movement data provided in **Figure 3.3**, there are no intersections that have a right turn volume equal to or higher then 30 vph; therefore, while the warrant criteria is meet for the daily traffic volumes, the second warrant criteria for the right turn movement threshold of at least 30 vph is not meet. Therefore, no new right turn lanes are required; however existing turn lanes should be lengthened.

The intersection analysis shows that the existing operations are acceptable. No immediate improvements are warranted or recommended.

3.4 Accident History

Coconino County provided accident data for the years 1996 – 2006. **Table 3.5** shows a summary by type. A review of the type of accident shows that many are not affected by roadway geometry and/or cross-sectional features. The accidents that are potentially influenced by roadway design are the rear-end accidents. However, since the existing geometry is sufficient to provide adequate SSD, driver error is a significant part of the cause. Also note, there are only

Table 3.5
TW Rd Accident Data
US 89 to I-40, Year 1996 - 2006

TOWNSEND-WINONA ROAD		
Reported Accidents		
(1996 - 2005)		
Snow / Ice	27	18%
Animals	27	17%
Other	25	16%
Failure to Control	15	10%
Inattention	14	9%
DUI	13	8%
Rear End	12	8%
Hit & Run	6	4%
Illegal Turn	4	3%
Excessive Speed	4	3%
Loose Cinders	3	2%
Failure to Yield	3	2%
TOTAL =	**153**	100%

12 rear-end accidents over a 10-year period. This does not constitute the kind of accident history that warrants corrective measures. That said, as volumes grow, additional turn lanes should be considered to remove turn traffic from the thru lanes along TW Rd.

3.5 Right-of-way

The as-built right-of-way plans show that a 100' wide symmetrical footprint has been provided for TW Rd. The only known deviation is along the last 2,100' approaching I-40. In this area the right-of-way transitions to a 200' wide footprint over in a length of 900' and maintains the 200' width for the remaining 1,200'.

Along Leupp Rd a consistent 100' right-of-way width is provided.

Figure 3.4 shows the public/private land ownership in the vicinity of the Project.

3.6 Cross-sectional Elements

TW Rd was-built as a 2-lane roadway with 12' wide lanes and a 5' shoulder on each side. The pavement is a crowned section with a cross-slope of 1.5% for both the roadway and shoulder. The engineered material was designed to provide a 4:1 slope. At the end of the engineered material the back slope varies to fit a controlled width within the right-of-way. In deeper cut and fill sections, the grading extends to within very close proximity of the right-of-way line.

Leupp Rd was built using the same pavement dimensions and grading template as TW Rd.

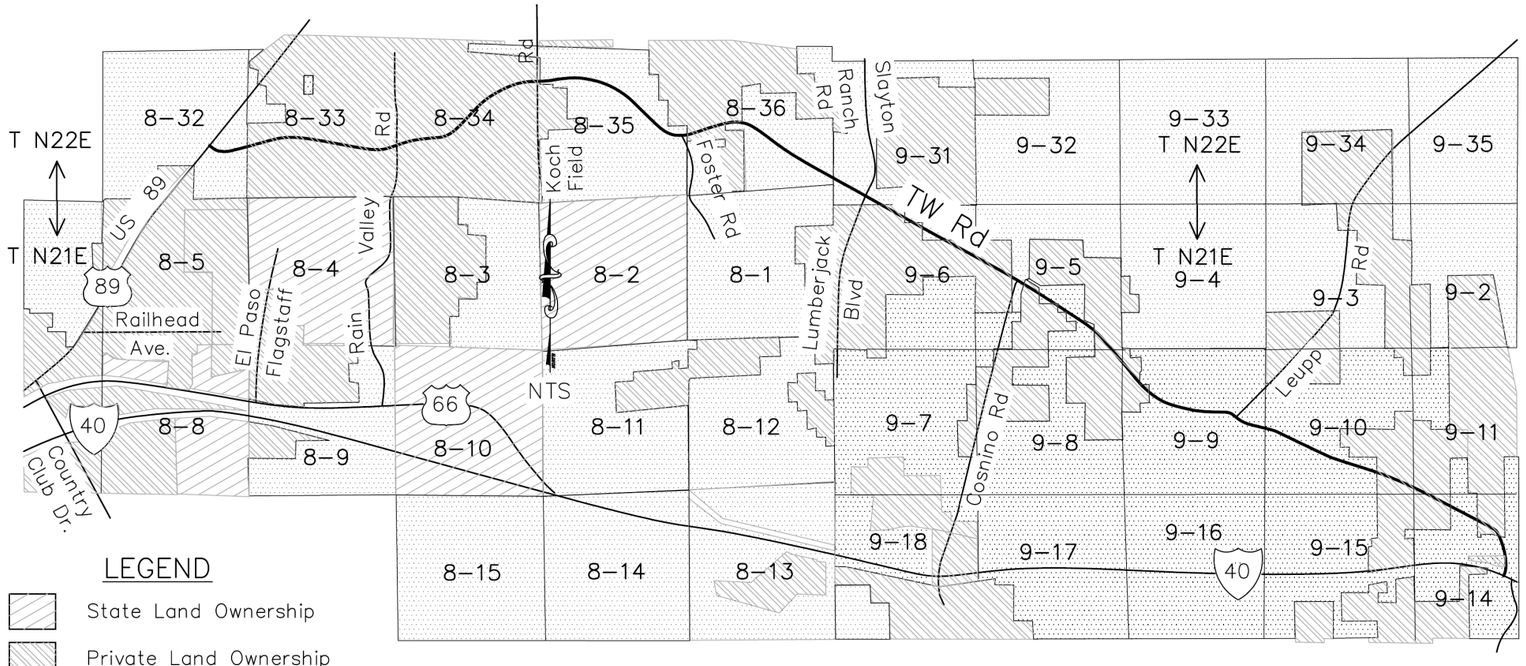


Figure 3.4

4. TW RD & LEUPP RD CORRIDORS FUTURE (YEAR 2030) CONDITIONS

The primary purpose of this Study is to determine the future infrastructure needs to provide for the safe and efficient movement of people and goods along the TW Rd and Leupp Rd Corridors. For this Study, the need for improvements will be identified when reasonable travel times can no longer be maintained within the existing and long term facilities current included in the FMPO Long Range Plan, see **Figure 2.1**. The LOS will be determined using the year 2030 travel demand forecast data provided by the FMPO. In addition to the delay caused by higher travel demand, the need for improvements may be determined by geometric and cross-sectional features, accident history, agency needs and public input.

4.1 Need for Future (Year 2030) Improvements

The year 2007 traffic count data, future travel demand for the year 2030 and a "buildout scenario" travel demand forecast using the residential data from **Table 2.1** for adjacent State and USFS Lands along TW Rd and Leupp Rd, is shown in **Figure 4.1**. The details for the data provided by the FMPO, is shown on page **A-12** in the appendices. Some minor increases or decreases were made on a few segments to balance traffic along the corridor. The volumes along the basic sections of TW Rd and Leupp Rd will not require more then 1-lane in each direction of travel. However, if at an intersection a traffic signal were required, the need for more thru lanes may then become one of capacity at the intersection. For example, if a traffic signal were required a the TW Rd/Koch Field Rd intersection and 2-thru lanes in each direction of travel were required to achieve acceptable delay, it may then be necessary to continue the 4-lane roadway west to the US 89 intersection. This phenomenon is a result of the red light effect which platoons traffic and releases them all at once. These platoons require more lanes as they continue on down stream.

Conclusion for Needs for Future Improvements. Based on the volume data provided by the FMPO, a 2-lane roadway, with 1-thru lane in each direction of travel, can carry the year 2030 traffic, and beyond in some locations. The alternatives analysis must consider the appropriate use of raised medians, left turn lane and right turn lanes in order to safely accommodate the varying traffic demand.

4.2 Alternative Basic Lane and Median Improvements

Based on the data provided by the FMPO and the basic lane capacity defined in *Section 3.3*, it is concluded that the long range needs for the TW Rd and Leupp Rd corridors will be met with a roadway that provides 1-lane in each direction of travel. Given these basic lane requirements, a variety of typical sections were considered. All the alternatives include wider shoulders and the addition of a multi-use path. Two of the alternatives include a continuous center left turn lane and one includes a raised median as a means to control access by limiting left turn movements.

Alternative 1 is shown in **Figure 4.2**. This typical section should only be used where the future average daily traffic (ADT) volumes are less then 6,000 vpd. This typical widens the existing shoulder from 5' to 10' and adds a path to one side of the road.

Alternative 2 is shown in **Figure 4.3**. This typical section should only be used where the future ADT volumes up to 13,500 vpd, with the appropriate right turn lane use. This typical was taken from the CCPW Standard Drawings. It adds a 13' wide continuous center left turn lane, widens the existing shoulder from 5' to 6.5' and adds a path to one side of the road.

Alternative 3 is shown in **Figure 4.4**. This typical section should only be used where the future ADT volumes up to 13,500 vpd, with the appropriate right turn lane use. It adds a 12' wide continuous center left turn lane, widens the existing shoulder from 5' to 10' and adds a path to one side of the road.

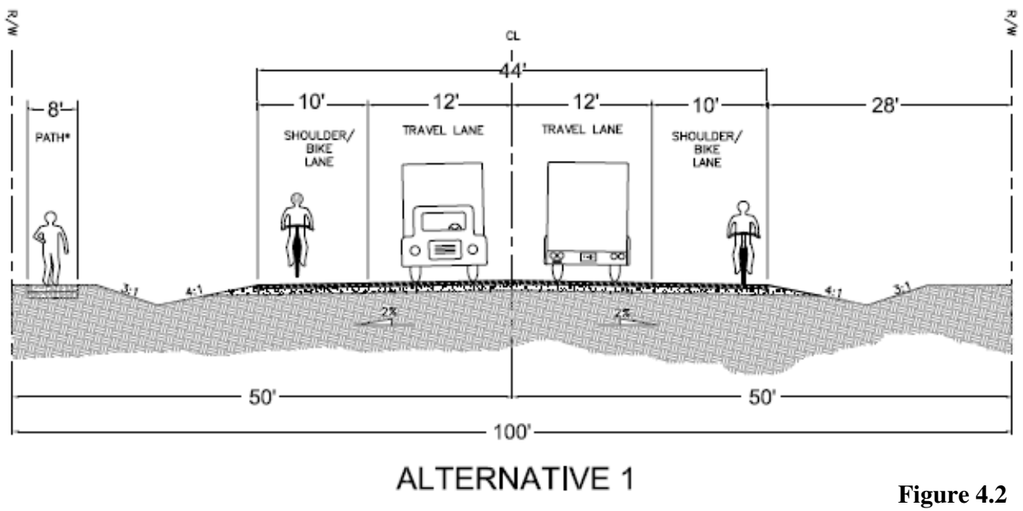


Figure 4.2

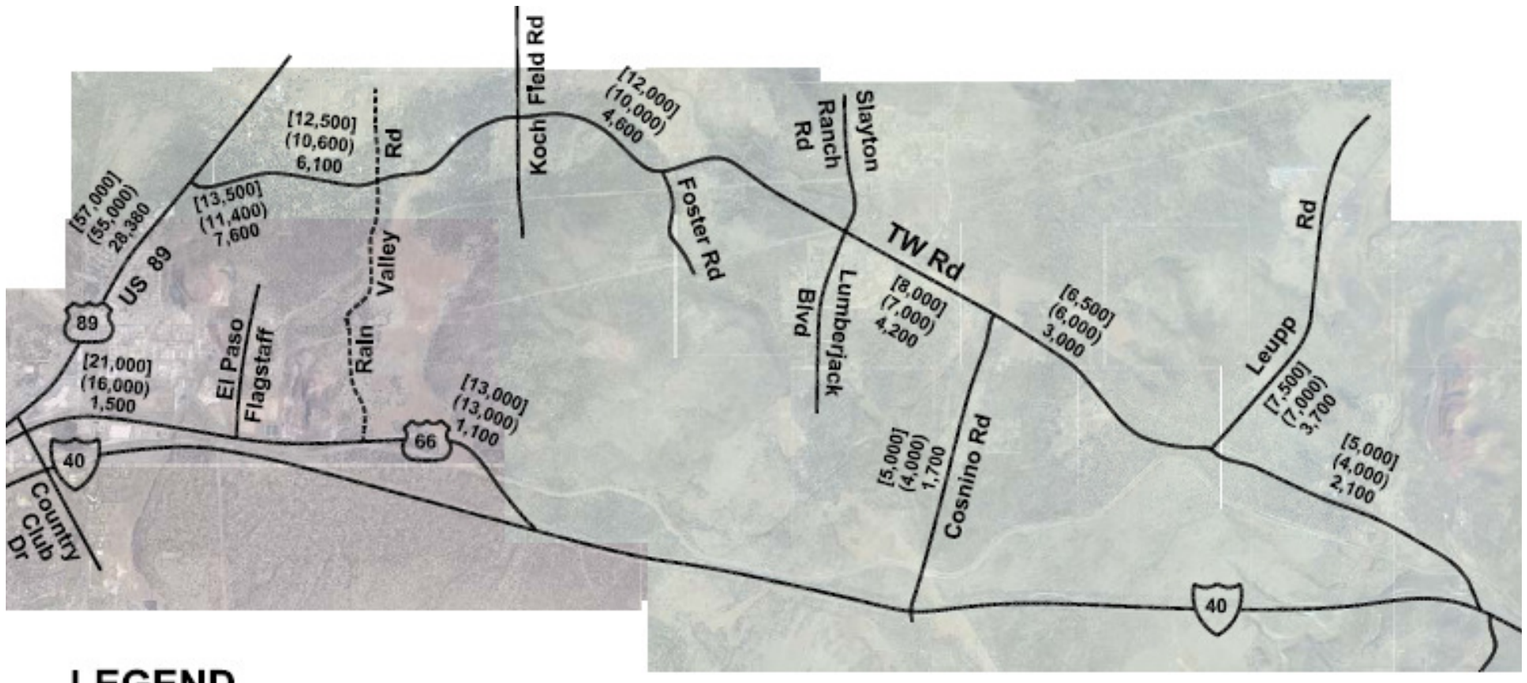
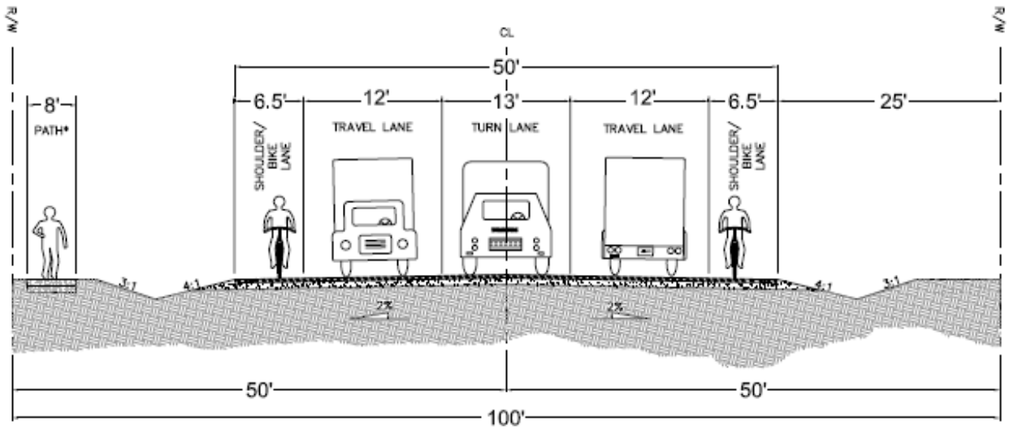


Figure 4.1

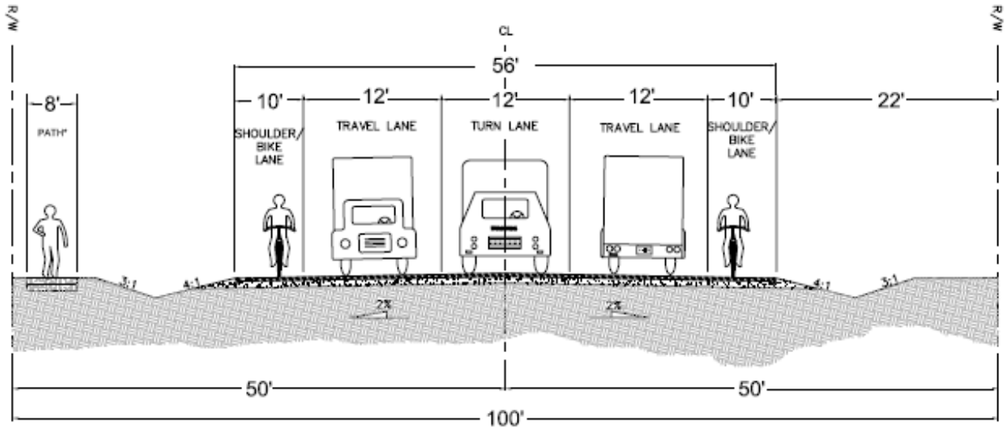
Alternative 4 is shown in **Figure 4.5**. This typical section can also be used where the future ADT volumes up to 13,500 vpd, with the appropriate right turn lane use. It adds an 8' wide raised median, widens the existing shoulder from 5' to 10' and adds a path to one side of the road. The raised median would eliminate the ability to turn left except for specific locations where the median was widened and a left turn bay provided.

Basic Lane and Median Evaluations. Based on the data provided by the FMPO and the basic lane capacity defined in *Section 3.3*, TW Rd between US 89 and Slayton Ranch Rd will use all the available capacity of a 3-lane roadway, assuming a continuous center left turn lane and an extensive use of right turn lanes, see the definition of *Threshold 3* on page 8, is provided. Between Slayton Ranch Rd and Leupp Rd a continuous center left turn lane with the limited use of right turn lanes, see the definition of *Threshold 2* on page 8, is required. East of Leupp Rd, a center left turn lane and right turn lanes are not required; however there is a section between milepost (MP) 429.53 and MP 430.36 where there is a heavy concentration of intersections along TW Rd where operations and safety would be enhanced by removing the left and/or right turn movements from TW Rd into a separate lane.



ALTERNATIVE 2

Figure 4.3



ALTERNATIVE 3

Figure 4.4

Right Turn Lane Evaluations. Along TW Rd, starting at US 89 to a point just east of the Rio Rancho Rd intersection, the extensive use of right turn lanes is warranted. Right turn lanes should be provided for every driveway and road intersection along TW Rd that generates 10 vph or more during any given hour of the day. The suggested lengths to be used for the right turn lane are provided in *Section 3.3*. A (15:1) 180' long taper should be used to introduce each right turn lane. Overlapping right turn lanes are not recommended.

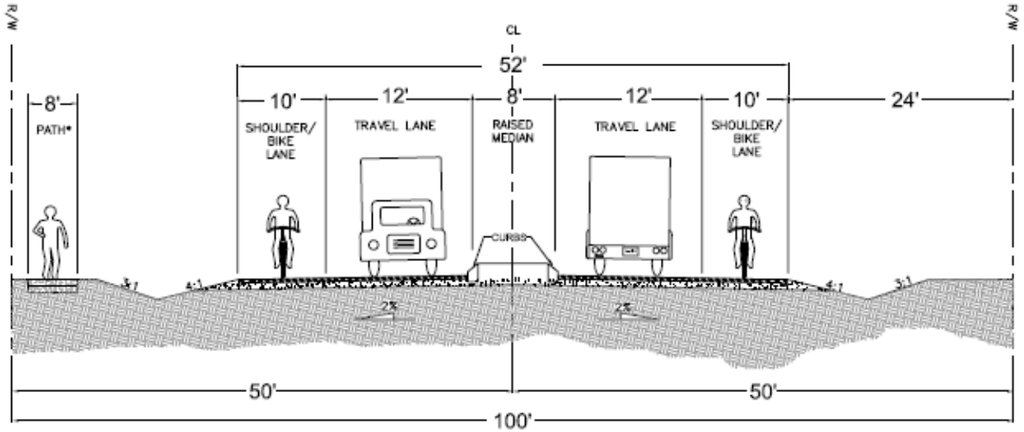
Along TW Rd, starting at Rio Rancho Rd to point just east of Leupp Rd intersection, the limited use of right turn lanes is warranted. Right turn lanes should be provided for every driveway and road intersection along TW Rd that generates 30 vph or more during any given hour of the day. The suggested lengths to be used for the right turn lane are provided in *Section 3.3*. A (15:1) 180' long taper should be used to introduce each right turn lane. Overlapping right turn lanes are not recommended.

The future travel demand along TW Rd between Leupp Rd and I-40; as well as all of Leupp Rd does not require a right turn lane. However, along the section of TW Rd between MP 429.53 and MP 430.36 where there are numerous driveway and local road intersections; if access management is implemented to consolidate driveways and local roads, right turn lanes are suggested for the remaining intersections.

Basic Lane, Median and Right Turn Lane Conclusions. The County was leaning toward the use of a continuous center turn lane along TW Rd between US 89 and Leupp Rd. The public was generally in agreement to use a continuous center turn lane instead of a raised median. Right turn lanes should be added as warranted and described herein.

4.3 Alternative Intersection Improvements

In this section the modern roundabout and traditional intersection will be evaluated. Each has advantages and disadvantages that need to be evaluated for this particular corridor. They are as follows:



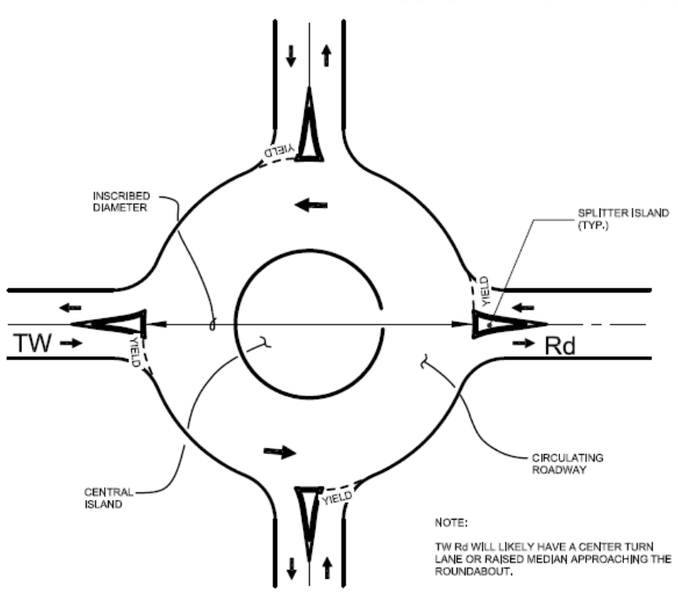
ALTERNATIVE 4

Figure 4.5

- The traditional intersections are already in place today; therefore, except for lengthening the left and right turn lanes there would be little change resulting in relatively low improvement costs as compared to providing a modern roundabout.
- The public is more familiar with the operations of a traditional intersection verses a modern roundabout.
- At a traditional intersection the approaches that are stop controlled will endure all the delay while flows on TW Rd and Leupp Rd would incur little delay. At a modern roundabout all approaches are yield controlled with the free movement going to those motorists already in the circulating roadway with the roundabout.
- Overall delay is shorter per vehicle with a modern roundabout then the traditional intersection. As the overall traffic volumes increase the modern roundabout will continue to provide lower overall delay while delay for the stop controlled approaches at a traditional intersection will increase quickly.
- Roundabout intersections allow traffic to flow in a random pattern while traditional intersections tend to platoon traffic more. This is particularly true when traffic signals are added. A platoon is less desirable as it may cause the need for additional thru lanes along a significant stretch of the road beyond the intersection.
- As delay on the stop control approaches increase at a traditional intersection, the stopped motorists will begin to make movements in smaller gaps of traffic. This eventually leads to more frequent and more severe accidents. When traffic volumes increase at a modern roundabout, the accident rates will slowly increase too; but the severity will not increase due to the overall lower travel speed inherent in roundabout operation and the geometry which reduces right angle, side swipe and sever rear-end accidents.

4.3.1 Traditional Intersection Design. The intersection LOS analysis provided in *Section 4.4* shows that the stop controlled approaches at the study intersections are going to a LOS D or better at most locations. However; looking at the details on pages **A-14** in the appendices shows that the southbound left/thru movement along Koch Field Rd will operate at a LOS F with an average delay of 58.4 seconds per vehicles (spv) in the PM peak hour. This duration of delay is not desirable; as it is the length of delay that will cause motorists to proceed when gaps along TW Rd are to short. When this occurs it usually causes thru motorists to slow down; and even brake sharply to avoid an accident. Normally a higher rate of accidents will occur and eventually a severe or fatality type accident will occur.

4.3.2 Modern Roundabout Design. A sample roundabout is shown in **Figure 4.6**. The existing posted speed limit along TW Rd and Leupp RD are currently reasonable given the traffic volumes and based on the feedback from public officials and the public. There was a limited amount of feedback that suggested that there is starting to be some close calls (accidents) at the more heavily traveled intersections along TW Rd; and emerging frustrations with the flow of traffic along the study corridors. Some of this feedback was associated with existing intersection operations and the perceived safety. As traffic volumes continue to increase, it may be appropriate to post a slightly lower speed limit to reflect the continued urbanization of the area along these facilities. One of the advantages of a roundabout style intersection is the natural tendency to lower travel speeds; which will be a good companion to the lower speed limit.



SAMPLE ROUNDABOUT
NTS

Figure 4.6

Another advantage of the modern roundabout is that it facilitates random trip movement instead of platooning traffic. This in essence allows a 2-lane roadway to carry more traffic. For this Project, the ability to keep trips random to maximize thru lane capacity a factor to maintaining 2-lanes instead of having to add a second lane in each direction of travel.

While this Study does not provide a detailed evaluation for the roundabout, the design speed criteria shown below is suggested for this roundabout:

- Entrance speed from TW Rd ➔ 25mph
- Exit speed to TW Rd ➔ 30 mph
- Entrance speed from side road approaches ➔ 25 mph
- Exit speed to side roads ➔ 25mph
- Speed through the roundabout ➔ 25mph

Intersection Conclusions. Given the positive affect roundabout have on allowing for higher volumes on the basic thru lanes; the reduce delay and lower severity and frequency of accidents at intersections, the modern roundabout intersection is suggested at the following locations along the TW Rd corridor:

- Rain Valley Rd,
- Koch Field Rd,
- Rio Rancho Rd,
- Slayton Ranch Rd / Lumberjack Blvd,
- Cosnino Rd, and
- Leupp Rd.

4.4 Future (Year 2030) Traffic Demand

A more detailed breakdown of the future travel demand along TW Rd and Leupp Rd is shown in **Figure 4.7**. The data was provided by the FMPO, as shown on page **A-12** in the appendices. The volumes along the basic sections of TW Rd and Leupp Rd will not require more then 1-lane in each direction of travel. However, if at an intersection a traffic signal were required, the need for thru lanes may then become one of capacity at the intersection. For example, if a traffic signal were required at the TW Rd/Koch Field Rd intersection and 2-thru lanes in each direction of travel are required to achieve acceptable delay, it may then be necessary to continue the 4-lane roadway to the west to the US 89 intersection. This phenomenon is a result of the red light effect which captures a platoon of traffic and releases them all at once. These platoons require more lanes as they continue on down stream.

The year 2030 turn movement traffic forecast at the study intersections is shown on **Figure 4.8**. The volume data was generated by taking a proportional increase in movements based on the percentage increase between the year 2007 traffic count data and the year 2030 travel demand forecast for each leg of the intersection. Some minor balancing was needed to get the total approach volumes to correspond to the turn movement volumes.

4.4.1 Evaluation of Year 2030 Intersection Traffic. The intersection operations were evaluated for the year 2030 travel demand. The data provided in **Figure 4.8** shows the volumes for the US 89, Koch Field Rd (KF Rd), Cosnino Rd, Leupp Rd and I-40 ramp intersections. Since the intersection of US 89/TW Rd was recently reconstructed to provide a 2nd WB to SB left turn lane and other improvements; no analysis of this intersection is provided. To ensure that the TW Rd, Cosnino Rd and Leupp Rd intersections will be functioning at an acceptable LOS, they were analyzed using the *HCS*. **Table 4.1** summarizes the results of the analysis. Pages **A-13 to A-16** shows the detailed results. All the movements will operate at a LOS C or better except the SB and NB approach along Koch Field Rd in the PM peak hour; which will operate at a LOC D and LOS E, respectively. The details show the SB left/thru movement will operate at a LOS F with an average delay of 58.4 seconds per vehicle.

Table 4.1
TW Rd Unsignalized Intersection Analysis
Year 2030

Intersection			A.M. Peak			P.M. Peak		
			vph	Delay	LOS	vph	Delay	LOS
TW Rd / Koch Field Rd	EB	Lt	50	8.2	A	200	8.6	A
	WB	Lt	5	7.6	A	5	8.5	A
	NB	Lt/Th/Rt	10 / 5 / 5	16.4	C	10 / 5 / 5	35.5	E
	SB	Lt/Th/Rt	70 / 5 / 150	13.2	B	55 / 5 / 75	31.5	D
TW Rd / Cosnino Rd	WB	Lt	90	90	A	30	8.0	A
	NB	Lt/Th/Rt	55 / 0 / 10	12.1	B	180 / 0 / 85	16.6	C
TW Rd / Leupp Rd	EB	Lt	90	7.6	A	310	8.4	A
	SB	Lt/Th/Rt	170 / 0 / 160	13.3	B	65 / 0 / 135	16.8	C

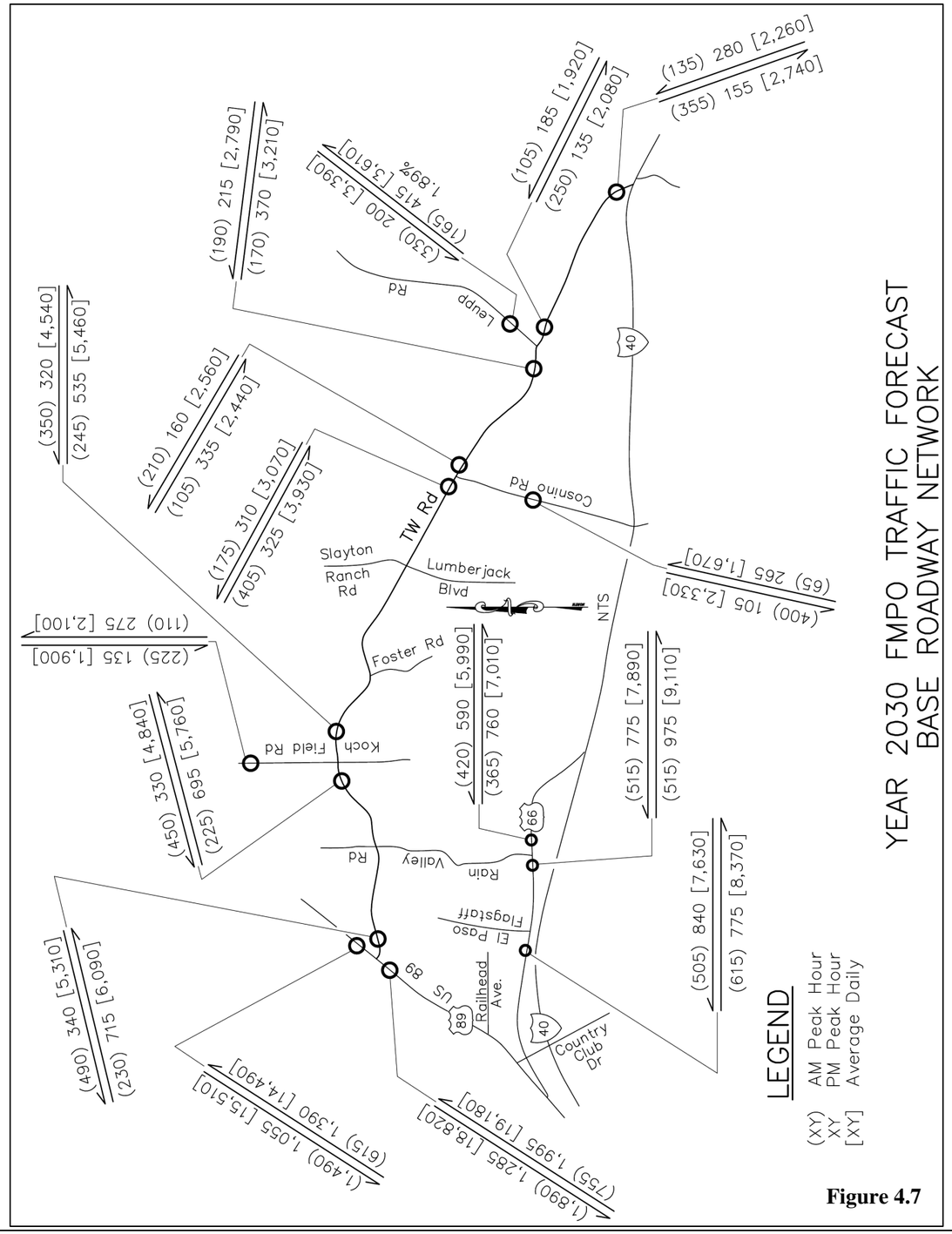


Figure 4.7

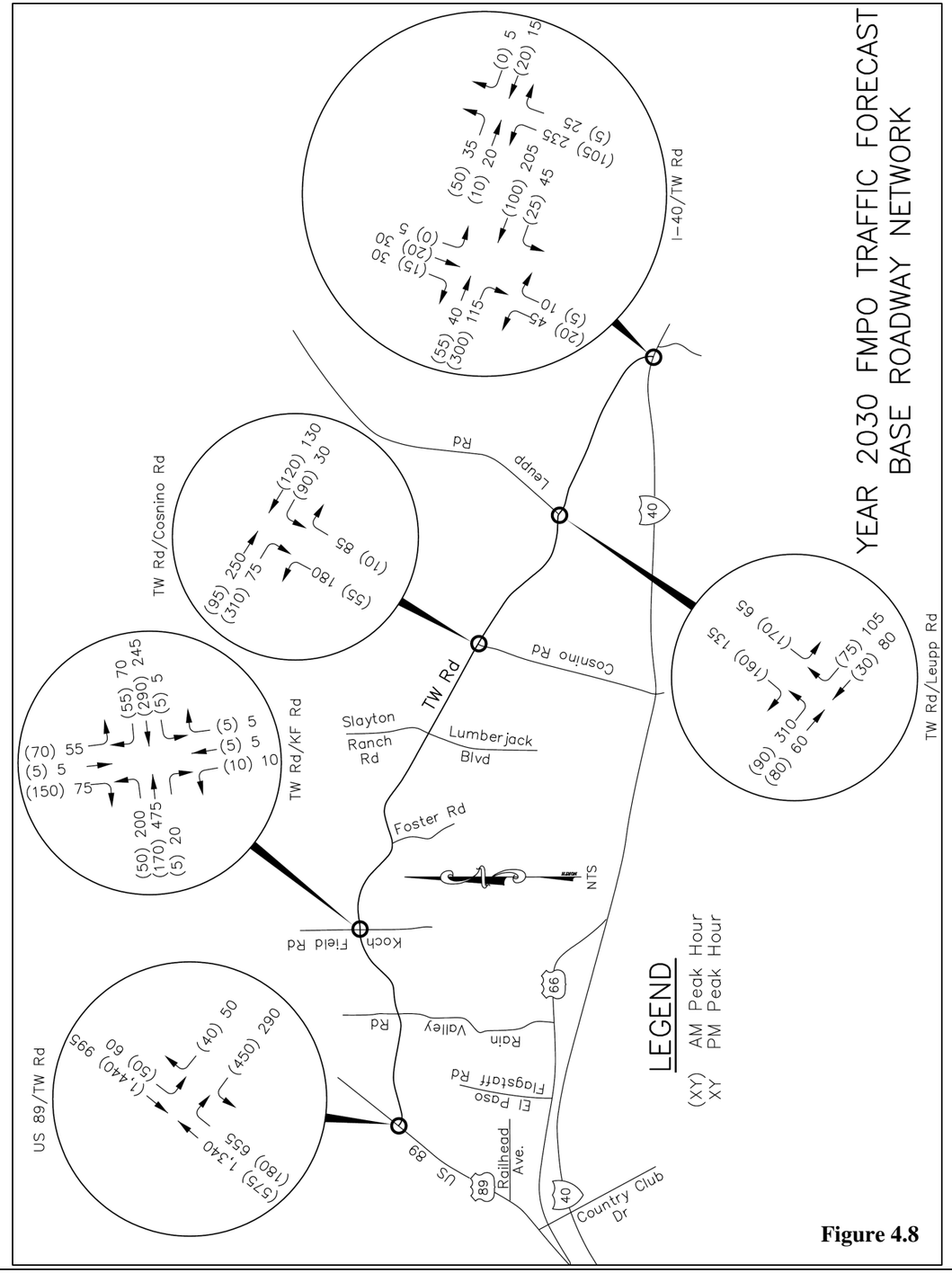


Figure 4.8

The analysis provided in **Table 4.1** shows the vehicles along the SB and NB approach on Koch Field Rd in the PM peak hour will operate at a LOC D and LOS E, respectively. In an attempt to improve operations, a 2nd lane in each direction of travel along TW Rd was added to the analysis. **Table 4.2** summarizes the results of the analysis see page **A-16**. The SB and NB approach along Koch Field Rd in the PM peak hour will operate at a LOC C and LOS D, respectively. The details show the SB left/thru movement will operate at a LOS E with an average delay of 37.8 seconds per vehicle.

Table 4.2
TW Rd Unsignalized Intersection Analysis
Year 2030
(4-Lane TW Rd @ Koch Field Rd)

Intersection			P.M. Peak		
			vph	Delay	LOS
TW Rd / Koch Field Rd	EB	Lt	200	8.6	A
	WB	Lt	5	8.5	A
	NB	Lt/Th/Rt	10 / 5 / 5	30.3	D
	SB	Lt/Th/Rt	55 / 5 / 75	22.0	C

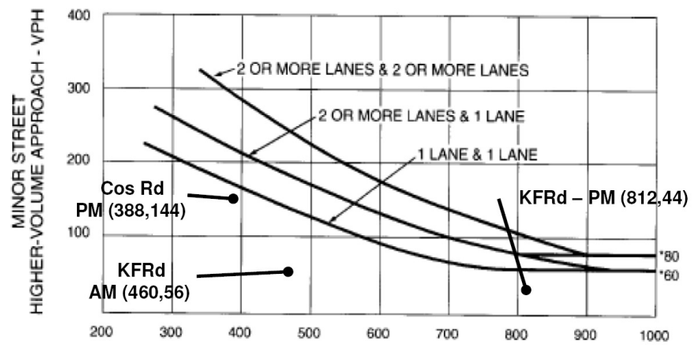
4.4.2 Signal Warrant Analysis for 2030 Travel Demand. The *HCS* intersection analysis at Koch Field Rd provided poor enough operations that it was deemed necessary to consider the *MUTCD Signal Warrants* to determine with a traffic signal would be warranted. It was also decided to look at the PM peak hour signal warrants at the Cosnino Rd intersection due to the very high NB to WB left turn demand. Only Warrants 2 (the Four-Hour) and 3 (the Peak Hour) were considered.

Figure 4C-2 shows the *MUTCD* analysis for the Four-Hour Warrant. ***Figure 4C-4*** shows the *MUTCD* analysis for the Peak Hour Warrant. The 70% factor was used because the posted speed limit on TW Rd is higher the 39 mph. In all cases the signal warrants are not met.

Conclusions for Year 2030 Intersection Traffic. *Section 4.1* shows that 1-lane in each direction of travel is adequate along the basic lane sections; assuming the appropriate use of right and left turn lanes is used. In *Section 4.4* the analysis shows that both the traditional intersection and modern roundabout intersection are viable; however the delays using the traditional intersection will reach a LOS E and LOS F for specific movements and or approaches at some locations.

Figure 4C-2. Warrant 2, Four-Hour Vehicular Volume (70% Factor)

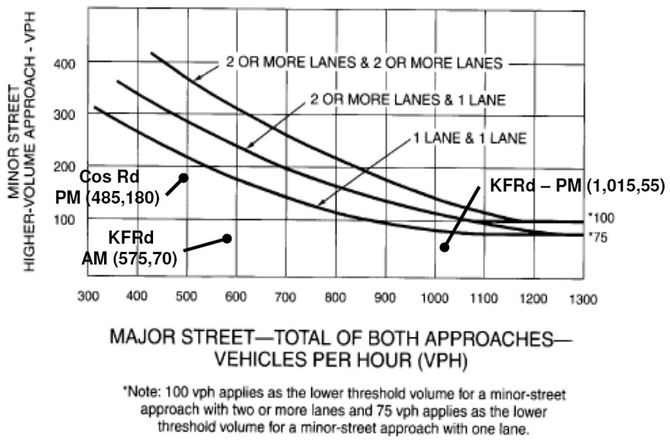
(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 70 km/h OR ABOVE 40 mph ON MAJOR STREET)



*Note: 80 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 60 vph applies as the lower threshold volume for a minor-street approach with one lane.

Figure 4C-4. Warrant 3, Peak Hour (70% Factor)

(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 70 km/h OR ABOVE 40 mph ON MAJOR STREET)



*Note: 100 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 75 vph applies as the lower threshold volume for a minor-street approach with one lane.

While a detailed analysis has not been provided herein for the roundabout alternative, we did run the roundabout *HCS* analysis for the Koch Field Rd intersection for the year 2030 PM peak hour condition. The analysis shows that the volume/capacity (v/c) ratio was 0.69, 0.36, 0.03 and 0.16 seconds for the EB, WB, NB and SB approaches, respectively. These results are better then those provided by the traditional intersection.

Therefore, it is recommended that modern roundabout intersections be used at the 6-locations outlined in *Section 4.3.2*.

4.5 Access Management

Access management is a tool used by public agencies to improve the capacity, operations and safety of roads. The basic principle is to limit the number, location and type (thru, left and right) movements. Three types of access management will be considered for this Project:

1. Limit left turns with the use of a raised median,
2. Limit driveways, particularly next to the major intersections, and
3. Combine access (frontage roads and joint access agreements).

4.5.1 Raised Medians. Alternative 4, **Figure 4.5**, shows the typical with a raised median that would eliminate the option of making left turns along TW Rd. As volumes along a 2-lane roadway exceed 9,000 vpd the advantages of eliminating left turn movements is evident in improved flow for thru traffic and reduced accidents. Because the section of TW Rd that will exceed the 9,000 vpd threshold by the year 2030 is already heavily populated by driveway and roadway intersections, the use of a raised median is not attractive. So, while it is desirable from an operator's perspective, it is not very palatable to the adjacent property owners; therefore, it would be difficult to implement.

Conclusions for Raised Medians. While very desirable from a roadway user perspective, raised medians are punitive to adjacent land owners; therefore, not recommended for general use. A variance is recommended at the approach to each roundabout. A raised median is recommended for a distance of at least 150' in advance of each roundabout along TW Rd and Leupp Rd; and for a distance of 75' in advance of each of the streets approaching TW Rd. This short section of raised median is suggested to eliminate left turn movements in the critical transition area for traffic approaching and departing a roundabout.

4.5.2 Limiting Driveways Next to Major Intersections. The principal here is the same as previously described for the use of a raised median at roundabout intersections. That is to eliminate conflicts in the critical transition area at an approach to a major intersection in order to improve operations and safely. **Figure 4.9** shows that no driveways should be allowed or a distance of 150' from the centerline (CL) of the intersecting roadway on either side along any approach to a major intersection.

Conclusions for Limiting Driveway Next to Major Intersections. It is recommended that driveways not be allowed with 150' of the centerline of the intersection street at the Rain Valley Rd, Koch Field Rd, Rio Rancho Rd, Slayton Ranch Rd / Lumberjack Blvd, Cosnino Rd, and Leupp Rd roads.

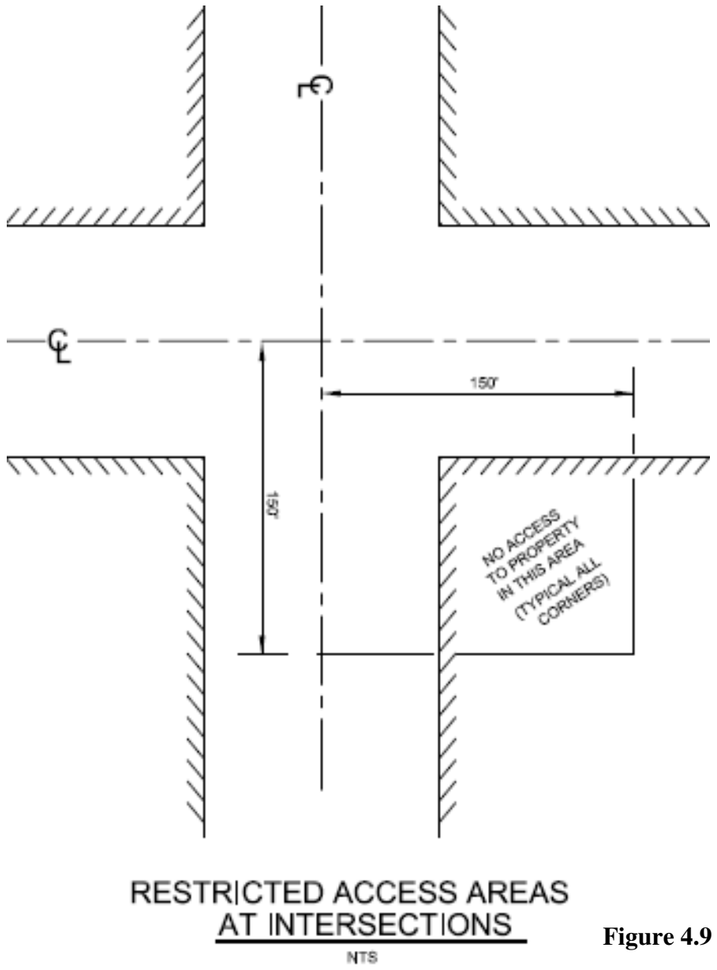


Figure 4.9

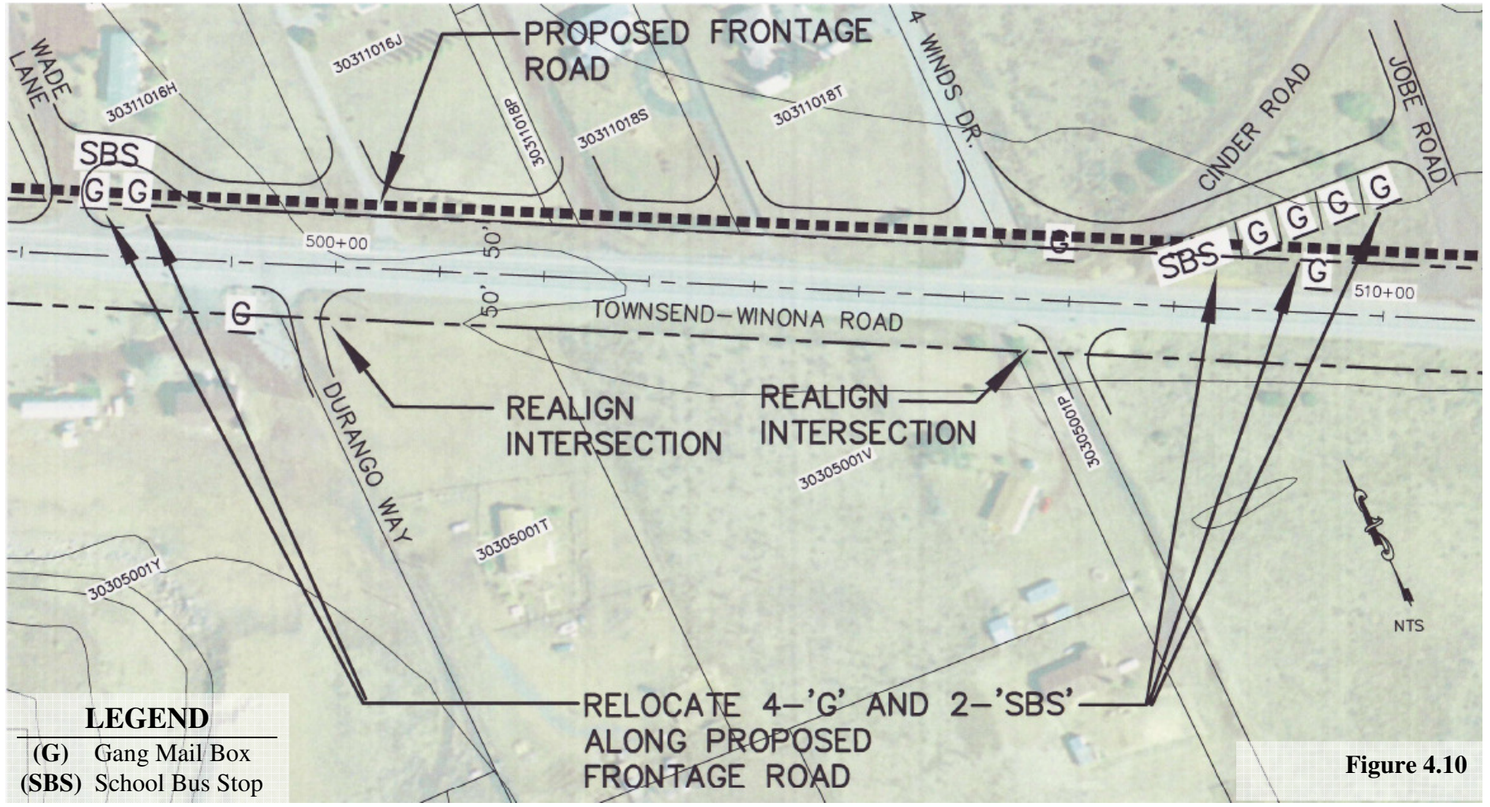


Figure 4.10

4.5.3 Combining Access (Frontage Roads and Joint Access Agreements). The principal here is that numerous driveway or street intersections that are closely spaced along a roadway lowers capacity and causes worse operational and safety impacts then fewer access points or better spaced access points. To limit access, a frontage road could be used to provide one or two intersections along TW Rd or Leupp Rd; then individual access to each parcel would come off the frontage road. It is important that the use of a frontage road have reasonable impacts on adjacent properties. This would mean that very few homes or major building would have to be removed. It would also not be reasonable to leave a home to close to a proposed frontage road.

Between MP 421.0 and 423.1; MP 425.9 and 428.0; and along Leupp Rd, it would be desirable to use frontage roads due to the number of driveway and street intersections. However; there are numerous homes and major structures that are very close to the existing R/W; therefore long stretches of a frontage road are not possible. There are however shorter stretches of frontage that have not developed yet. It may be reasonable to allow 1-point of access for 2 or more properties with a frontage road or a private joint access agreement (JAA); which in essence is a privately owned frontage road.

Between MP 423.1 and 425.9; MP 428.0 and 429.5; and MP 430.4 and MP 430.9 the majority of the adjacent property is owned by the USNF; except for a short stretch between MP 424.0 and 424.6 that is privately owned. If the area that is now owned by the USNF land is ever developed, no direct access for an individual parcel should be allowed. Between MP 426.0 & 424.6, most of the privately owned land on the north side of TW Rd is served by a circulation road; therefore has no direct access to TW Rd. The short area of privately held land on the south side of TW Rd has a combination of combined access and individual access. Because of the curves on TW Rd in the area, it would be desirable to combine as many access points as possible wit a frontage road or have the owners work out a JAA.

Between MP 429.5 and MP 430.4 the property north of TW Rd is privately owned and there are multiple driveway and street intersections. Most of the homes and major buildings are set back far enough to accommodate a frontage road. **Figure 4.10** shows a sample plan for frontage roads in this area. The frontage road should be roughly 24' – 28' in width.

Conclusions for Combining Access. It is recommended that frontage roads be; 1) required along existing stretches of the lands currently owned by the USFS if it were to ever be traded and developed, 2) considered along TW Rd to consolidate access between MP 429.5 and MP 430.4, 3) added where possible as joint access agreements between private owners, possibly as simple as a common driveway at the property line, for the developed and undeveloped parcels between MP 421.0 and 423.1; MP 425.9 and 428.0; and along Leupp Rd.

4.6 Mailbox and Bus Pullouts.

There are numerous mailboxes and school bus stops (SBS) along the TW Rd corridor as shown in the Plans. While the operations of the users has to date has not been marked by accidents or unreasonably long delays; this will likely change as traffic volumes increase. Today along the section of TW Rd between US 89 and Koch Field Rd the frequent stopping by motorists dropping their children off at SBS is uncomfortable. Therefore, a few pullouts that allow a motorist to drop off their children at these SBS and for the school buses to pick the children up have been provided; but, their layout is a bit tight.

The operations of the motorist dropping off and picking up mail is similar; however, because the vehicles dropping off the mail tend to be between the AM and PM peak hours, the discomfort for these drivers is somewhat less then that experienced by the users of the SBS. The motorists who pick up their mail are more commonly occurring in the PM peak period when background traffic volumes are higher.

To address these operational and safety concerns a range of alternatives where developed; based on *The Guidelines for Erecting Mailboxes On Highways*, 1994 by AASHTO. The first two alternatives are the near side and far side options to place the traditional cluster mailbox either in advance of an intersection or after and intersection, respectively. **Figure 4.11** shows the proposed design for the near side mailbox. The key elements of the design are the 300' offset from the downstream intersection, the widening, and the approach and departure tapers. **Figure 4.12** shows the cross section in the vicinity of the mailboxes. **Figure 4.13** shows the proposed design for the far side mailbox. The design elements are the same; except that the offset is 200' from the upstream intersection.

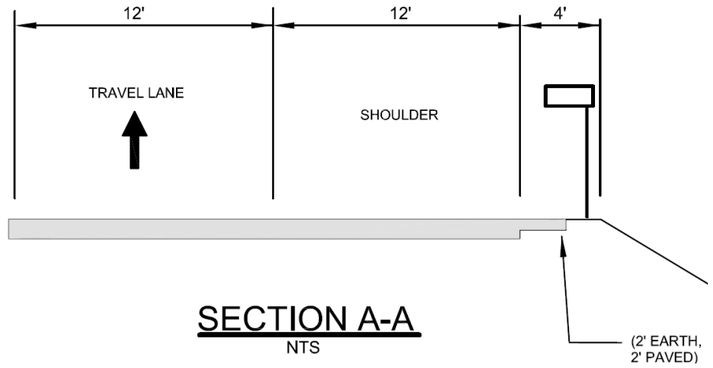


Figure 4.12

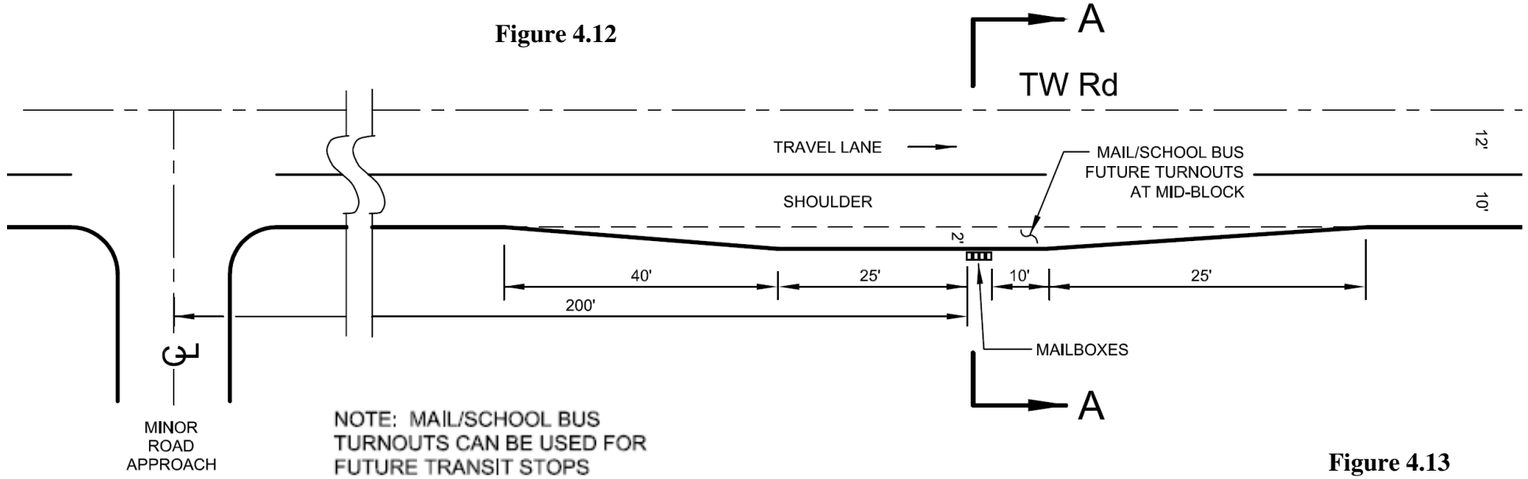


Figure 4.13

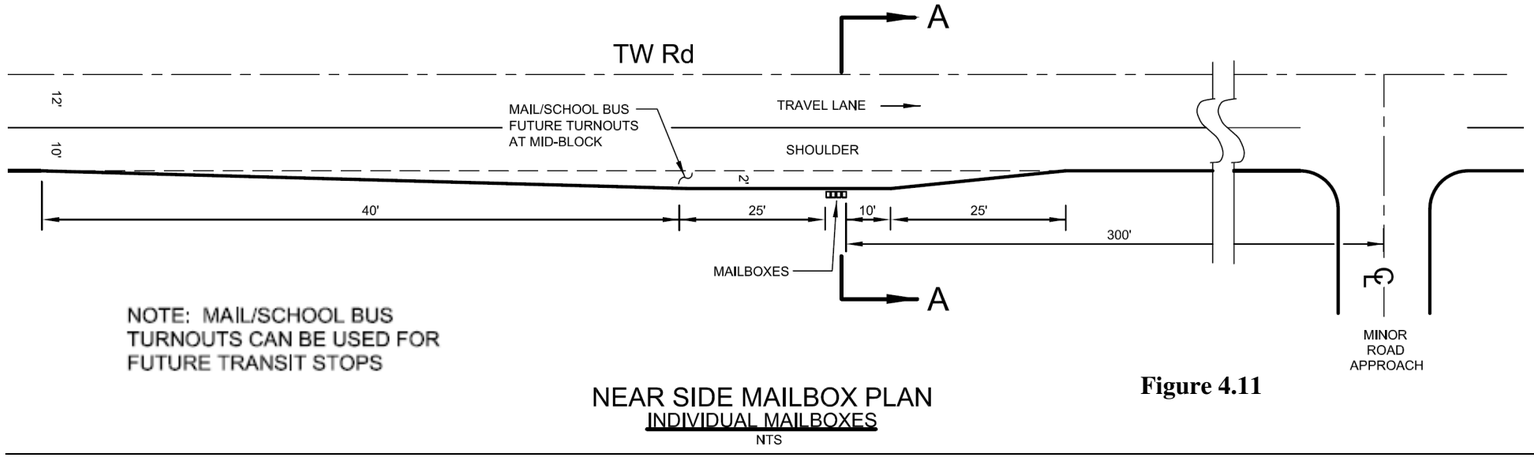


Figure 4.11

While these designs are specifically provided for cluster mail box pullouts, they are also better locations for SBS then what exist today. Where it is known that a mailbox turn out is going too also be used as a SBS, it is suggested that the 10' length down stream from the mailbox be lengthened to 25'. It is also recommended that the 4' area behind the shoulder for the mailbox, as shown on **Figure 4.12**, be extended for the entire 25' so that passengers can stand on this area to wait, load and unload. It is suggested that the entire 4' area be paved.

The next two alternatives are for the gang type mailbox, as shown in **Figure 4.14**. The roadway plans (both near side and far side) for the gang type mailbox, see **Figure 4.15**, are similar to that of the cluster type mailbox; except a wider shoulder, see **Figure 4.16**, is provided and a parking area for the postal vehicles is provided. These improvements are provided for two reasons. First, while the postal worker remains in the vehicle to drop off mail at a cluster type mail box; they must park their vehicle and load the gang type mailbox from the rear. Second, there will be more people picking up mail and they too will have to get out of there vehicle to get the mail out of the mailbox.

Figure 4.14

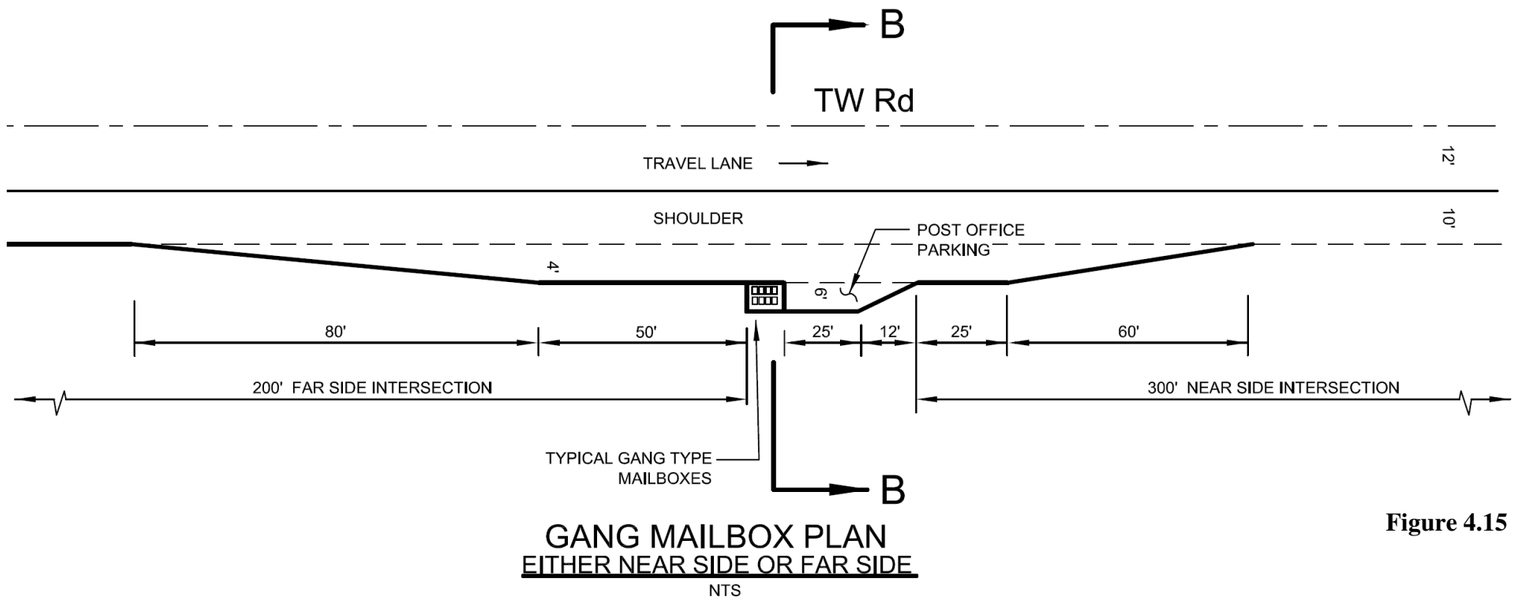


Figure 4.15

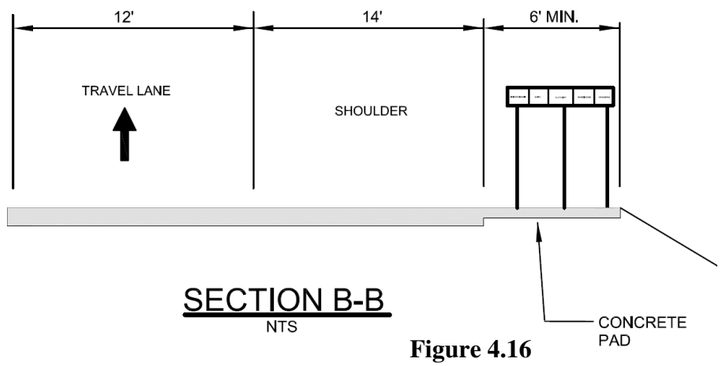


Figure 4.16

While these designs are provided for gang type mail box pullouts, they too are better locations for SBS then what exist today. No additional improvements are suggested to use this design as for SBS.

During the design of the mail box pullout alternatives, it was noted that there will be locations where right turn lanes will be warranted at the downstream intersection. **Figure 4.17** shows a plan that that incorporates a right turn decel lane with a near side cluster mailbox pullout. This design is also a good safety feature to be used in conjunction with the SBS, because parents would not have to pull back into the thru lane of travel the short distance to reach the downstream intersection.

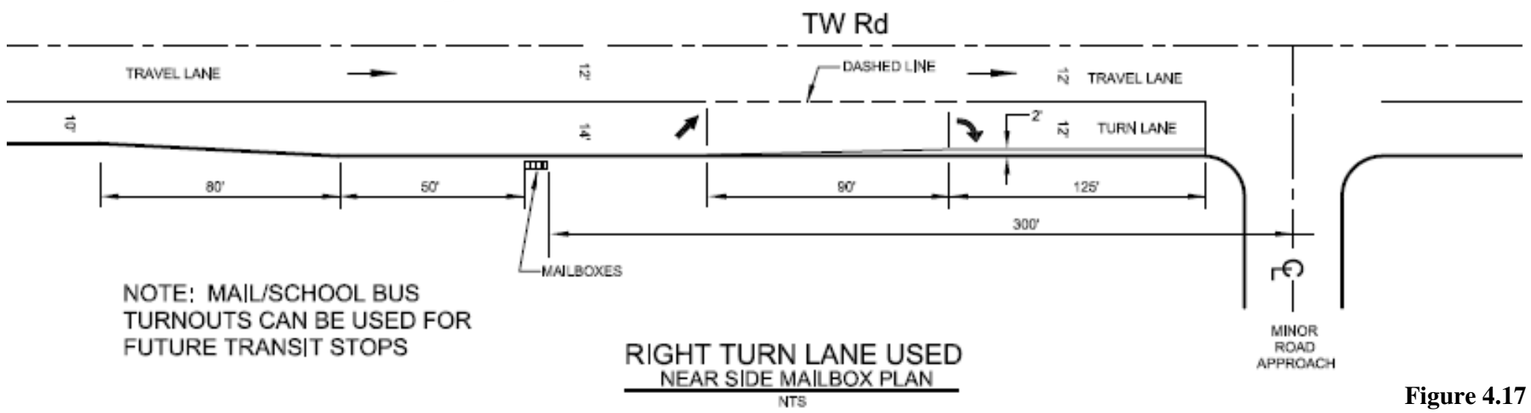


Figure 4.17

Another option for both mail boxes and SBS are provided if frontage roads are used. An example is provided on **Figure 4.10**. Note the plan calls for both mail boxes and SBS in the area to be relocated along the proposed frontage road. If this is done, no pullout design has been provided. The decision to provide an additional area for mail box and SFS pullouts will be made concurrent to the decision whether or not to use frontage roads.

Conclusions for Mailbox and Bus Pullouts. Site specific recommendations are not provided herein, so the final decision will occur in the future. In general the following appears reasonable:

- The near side type mail box pullout design is preferable,
- If used for a SBS, provide the right turn lane for the downstream intersection,
- At the time of final design, standards for bus stops should be reviewed to ensure the mail box design as shown is acceptable for dual use.
- All mailbox bases must be breakaway.

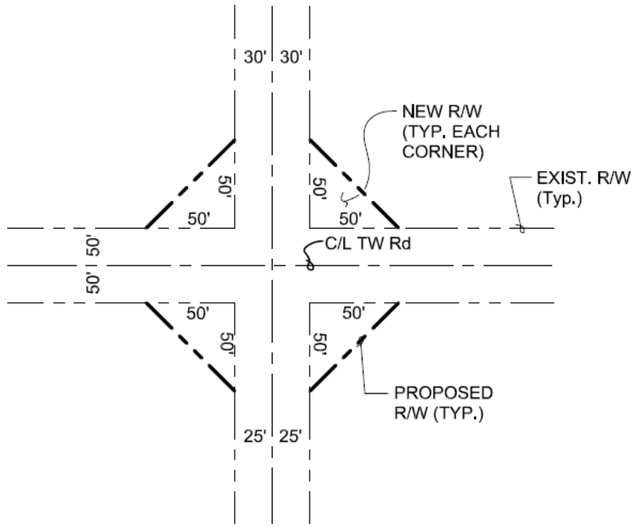
4.7 Right-of-way.

In general the widening along TW Rd and Leupp Rd to accommodate the wider shoulders, continuous center left turn lane and the path can be accomplished within the existing right-of-way. There will be isolated areas, based on field trip observations and the USGS mapping (at 1" = 20' contour intervals) that suggest new cut and fill slopes will spill over into private property in order to accommodate the wider pavement and path. In these areas, a more detailed design study, with the use of design quality horizontal and vertical data, are required to determine the best option; be it the acquisition of new R/W, the use of walls, curb & gutter, guard rail, barriers or a combination of these options.

The use of roundabout has been recommended at 6-main intersections along TW Rd. In order to estimate the need for R/W, a scaled sketch was developed. Based on the assumptions used in this sketch, **Figure 4.18** shows the estimated R/W needed at each of these 6 intersections. Existing grades will impact the amount of R/W needed. If during preliminary design the need for R/W is identified, the use of walls should be considered as an alternative. No guard rail or barrier is suggested.

When the detail LOS analysis is made for the roundabout at each intersection, it may be determined that a larger or smaller inscribed diameter will be needed, which will change the R/W requirements.

The R/W footprint provided herein assumes an inscribed diameter of 130'.



ROUNDABOUT RIGHT-OF-WAY REQUIREMENTS
ASSUMED 130' INSCRIBED DIAMETER
NTS

Figure 4.18

5. WEST & EAST ALTERNATIVE CORRIDORS – EXISTING CONDITIONS

At the request of the FMPO, this study an east and west alternative corridor was considered; to evaluate the potential traffic demand changes along the existing roadway segments. The east alternative corridor (EAC) to be considered was an extension of Koch Field Rd from its intersection along TW Rd to an undefined location along Route 66. The west alternative corridor (WAC) to be considered was a realignment of US 89 from its intersection with TW Rd to an undefined location along I-40. ADOT has previously indicated they were interested in an alternative corridor for existing US 89 between I-40 and TW Rd. As the evaluation process for the WAC evolved it became apparent that a local north-south corridor to augment the movement of local circulation would be necessary; therefore, the existing Rain Valley Rd corridor was used for this purpose.

Figure 3.4 shows the land ownership in the area of these corridors. Projecting the possible alignments for both the EAC between TW Rd and Route 66, and WAC between TW Rd and I-40 shows that these proposed routes would run through private, USNF and State Lands properties. The proposed EAC corridor would run close to existing homes, through undeveloped stands of trees and native meadows.

The proposed WAC would run close to existing homes, around the east side of the mining operations on Sheep's Hill, past the west side of the El Paso Natural Gas Pump Station, past the west side of the City of Flagstaff Waste Water Treatment Plant and over the railroad tracks that parallel Route 66. The option to go east of the Natural Gas Pump Station and Waste Water Treatment Plant was considered and screened from further consideration because it would place the WAC near and/or through the Picture Canyon area.

A roadway exists for the Rain Valley Rd corridor; however, it is currently truncated within a private parcel where public R/W for the road does not exist. The Rain Valley Rd corridor meanders through an area known as Picture Canyon as it approaches Route 66. This is a sensitive area that is a priority for the community to preserve from development.

6. WEST & EAST ALTERNATIVE CORRIDORS - FUTURE CONDITIONS

This Study also considers the movement of people and goods between the area to the north (defined as TW Rd Corridor and US 89 north of TW Rd), and the area to the south (defined as Route 66, Country Club Dr and I-40). The need for improvements will be determined by travel demand, agency needs and public input.

6.1 Need for Alternative Corridors

The need for improvements will be identified when reasonable travel times can no longer be maintained within the existing and long term corridors currently included in the FMPO Long Range Plan. Travel times will be defined by LOS along the Project Corridor. The LOS will be determined using the year 2030 travel demand forecast data provided by the FMPO.

Based on the volume data provided by the FMPO for the year 2030, see **Figure 4.1**, it is projected that the section of US 89 between Country Club Dr and Empire Ave will carry in excess of 53,000 vpd. In fact, the detailed data shown on page **A-12** shows there will be a short section of US 89 between Country Club Dr and Route 66 that will carry in excess of 65,000 vpd. Based on the operational guidelines provided in **Table 3.3**, provided by MCDOT on page 6, there is a 45,000 vpd threshold for a LOS D for a 6-lane roadway. Based on the comparison between the projected volumes and the threshold for a LOS D, undesirable levels of congestion and delay can be expected along US 89 in the vicinity of the Flagstaff Mall.

Conclusion for the Need for Alternative Corridors. Based on the volume data provided by the FMPO, portions of the 6-lane US 89 roadway will experience unacceptably long delays; therefore an alternative north-south corridor that relieves the future congestion along US 89 should be considered.

6.2 Alternative Corridors

As a beginning point, the EAC and WAC roadway networks were added to the FMPO travel demand forecast model to determine how they would impact TW Rd, US 89, Route 66, Country Club Dr and I-I-40. **Figure 6.1** shows the key volume data from these model runs, see page **A-17** for the detailed run provided by the FMPO. The volumes in the green corridor are for the EAC only condition. The EAC was coded as a 35 mph, 2-lane facility with frequent intersections and limited direct access for driveways. The results show that the EAC will attract less then 2,000 vpd off of TW Rd to the west and less the 1,000 vpd off of US 89 to the south.

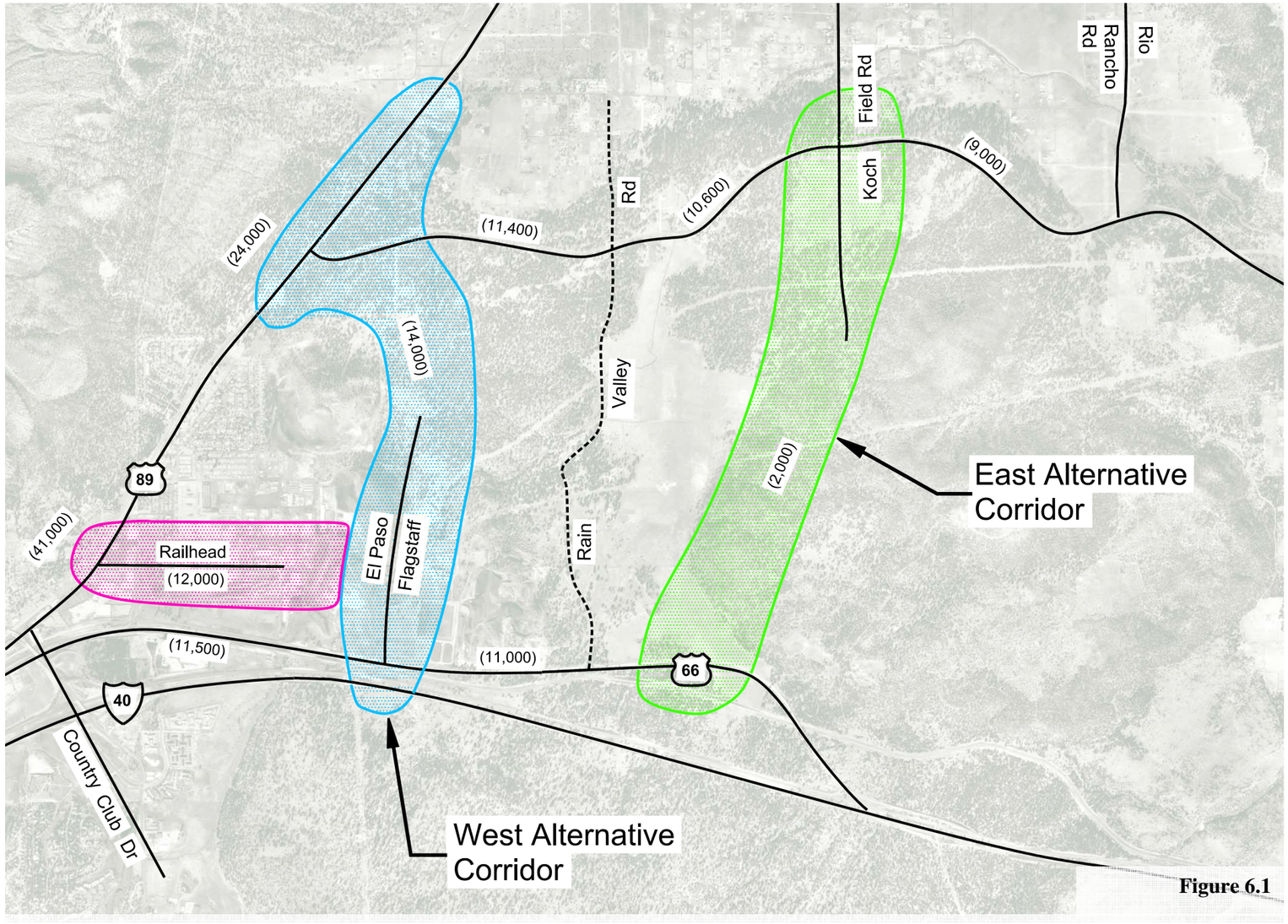


Figure 6.1

PURPOSE AND NEED TRAFFIC FORECAST - ALTERNATIVE CORRIDORS

The volumes in the blue shaded area are for the WAC only condition. This alternative included a connection to Railhead Ave and I-40 only. The WAC was coded as a 55 mph, 4-lane median divided facility with no access except as previously noted. The results show that the WAC will at attract roughly 14,000 vpd, have no impact on the volumes along TW Rd and take off roughly 12,000 vpd from the most congested area of US 89 between country Club Dr and the Flagstaff Mall.

Conclusion for Alternative Corridors. Based on the FMPO volume data, agency need and public convenience, it was recommended that the WAC be considered in the regional planning process. A second modeling iteration was made for the WAC alternative to refine the impacts to TW Rd, US 89, Route 66, Country Club Dr and I-40.

6.3 Refinement of the West Alternative Corridor

In addition to the Railhead connection to the WAC; the refined model for the WAC included an Empire Ave connection to the WAC and Rain Valley Rd and the Rain Valley Rd corridor was added as the local access and circulation facility on the east side of the WAC. The Empire Ave connection was coded as a 35 mph facility. The detailed data provided by the FMPO is provided on page **A-18**.

The travel demand on TW Rd, US 89, Route 66, Country Club Dr and I-40 did not change significantly from that provided on **Figure 6.1**. Drops in volumes of 1,000 vpd were seen on Route 66 and US 89 north of Country Club Dr. No changes were seen on TW Rd. A short section of the WAC incurred an increase of 1,000 vpd.

Conclusion for the Refined West Alternative Corridor. A north-south corridor was added to provide local access and circulation on the east side of the WAC. This is a necessary corridor as the WAC will not provide for this function. If the Rain Valley Rd corridor is not used, a new corridor must be identified in order to serve this role. The Empire Ave connection does not carry a lot of traffic, but is does reduce trip lengths for a number of local movements wishing to use the external (US 89 and I-40) regional roadway system. Therefore it is recommended that the WAC corridor and the aforementioned local corridors be considered for future development within the FMPO area. A map showing the conceptual corridors is shown on **Figure 6.2**. The WAC is defined by the blue corridor. Note by staying west of the Gas Pump Station and Waste Water Treatment facility, the Picture Canyon area is avoided. A R/W of 250' to 300' should be planned for the WAC. The green corridors show a possible location for Empire Ave and Railhead Ave. Empire Ave and Railhead Ave should be planned as a 3-lane roadway with a minimum of 70' of R/W. Rain Valley Rd is shown on the east side of the **figure**. A 2-lane section for Rain Valley Rd within 60' of R/W would be sufficient as long as a limited number of driveways are allowed.

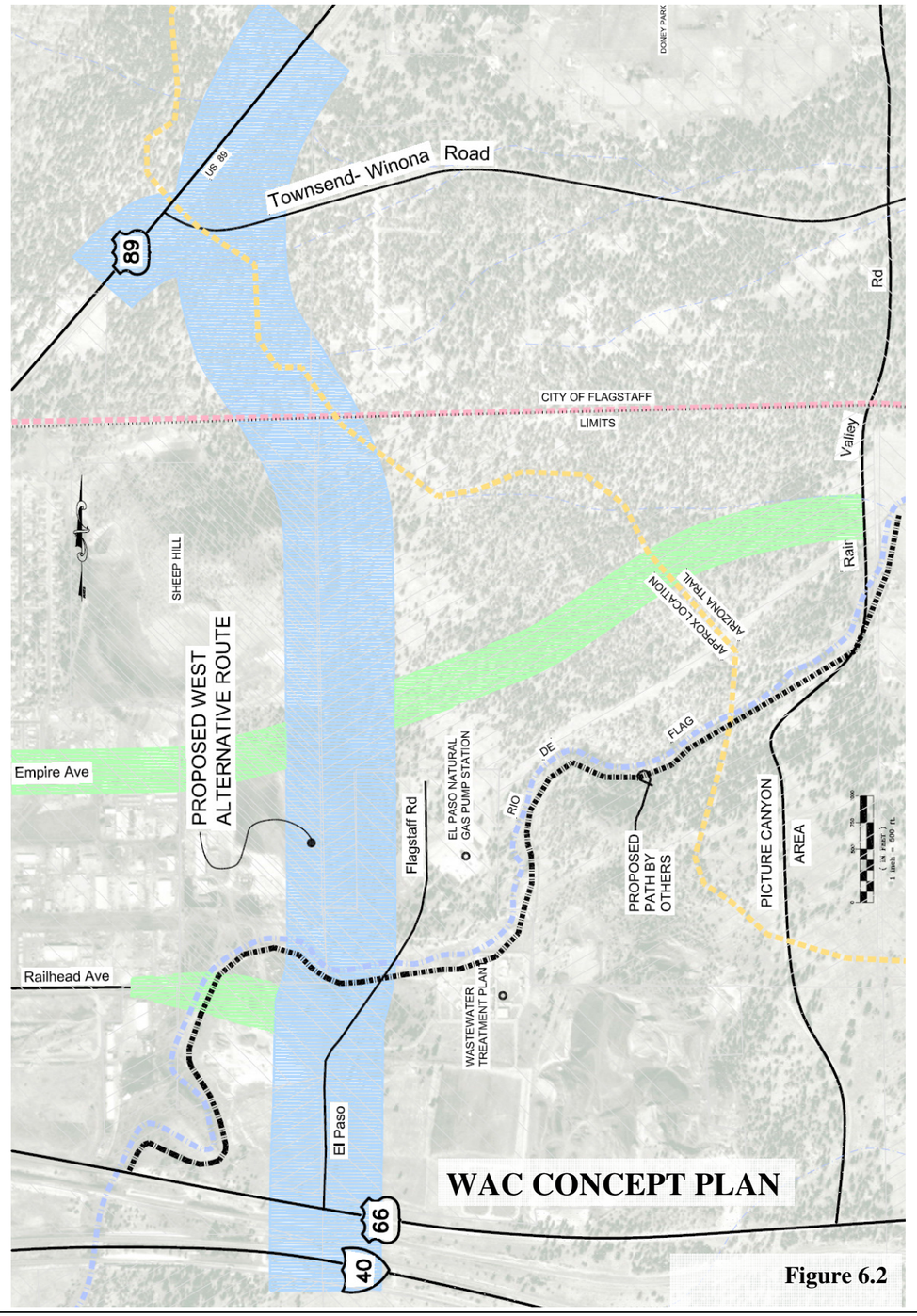


Figure 6.2

7. PATHWAY CONSIDERATIONS

The Coconino County Comprehensive Plan and the Doney Park Timberline Fernwood Area Plan stress pathways and trails. Their Plans suggest that when improvements are made to roadway corridors, such as TW Rd, the design should include upgrades to existing or the addition of new pathways.

7.1 Existing and Known Future Paths

Figure 7.1 shows the existing and known future pathway system in the vicinity of the Project; as published by the City of Flagstaff Advanced Planning Office/Community Investment Division, April 2006. The existing Arizona Trail (Flagstaff Bypass) is located south of TW Rd and runs from the US 89/TW Rd intersection to I-40 close to the Walnut Canyon interchange.

The present TW-Rd corridor has paved shoulders that are used as bike lanes, but does not have any pathways. There are pathways in the vicinity of TW Rd within adjacent neighborhoods and some portions of the Coconino National Forest that have not been shown on **Figure 7.1**. For example, along Koch Field Rd an existing pathway is located approximately 1,500 feet north of TW Rd. This path is connected to the pathway system in the Peaks View County Park and to the sidewalk system on Silver Saddle Road.

The proposed Picture Canyon Trail would run adjacent to the Rio De Flag from TW Rd thru Picture Canyon to Old Route 66. There is a proposed trail adjacent to Old Route 66 between the I-40/Walnut Canyon interchange and Country Club Dr. There is also a proposed trail adjacent to US 89 between Railhead Ave and TW Rd.

7.2 Potential Additional Paths

The TW Rd Corridor is a candidate for the location of a new path. As shown previously on the typical sections, a path could be located within the existing right-of-way along many sections of TW Rd. The Project Plans show the proposed location of a new path along the TW Rd Corridor. While the terrain along much of the TW Rd Corridor is conducive to the addition of a path, there are locations where the existing roadway is depressed or elevated a sufficient height so as to make it necessary to either purchase right-of-way or use retaining walls. These locations have not been identified; therefore, it would be necessary to do so at the next level of project development.

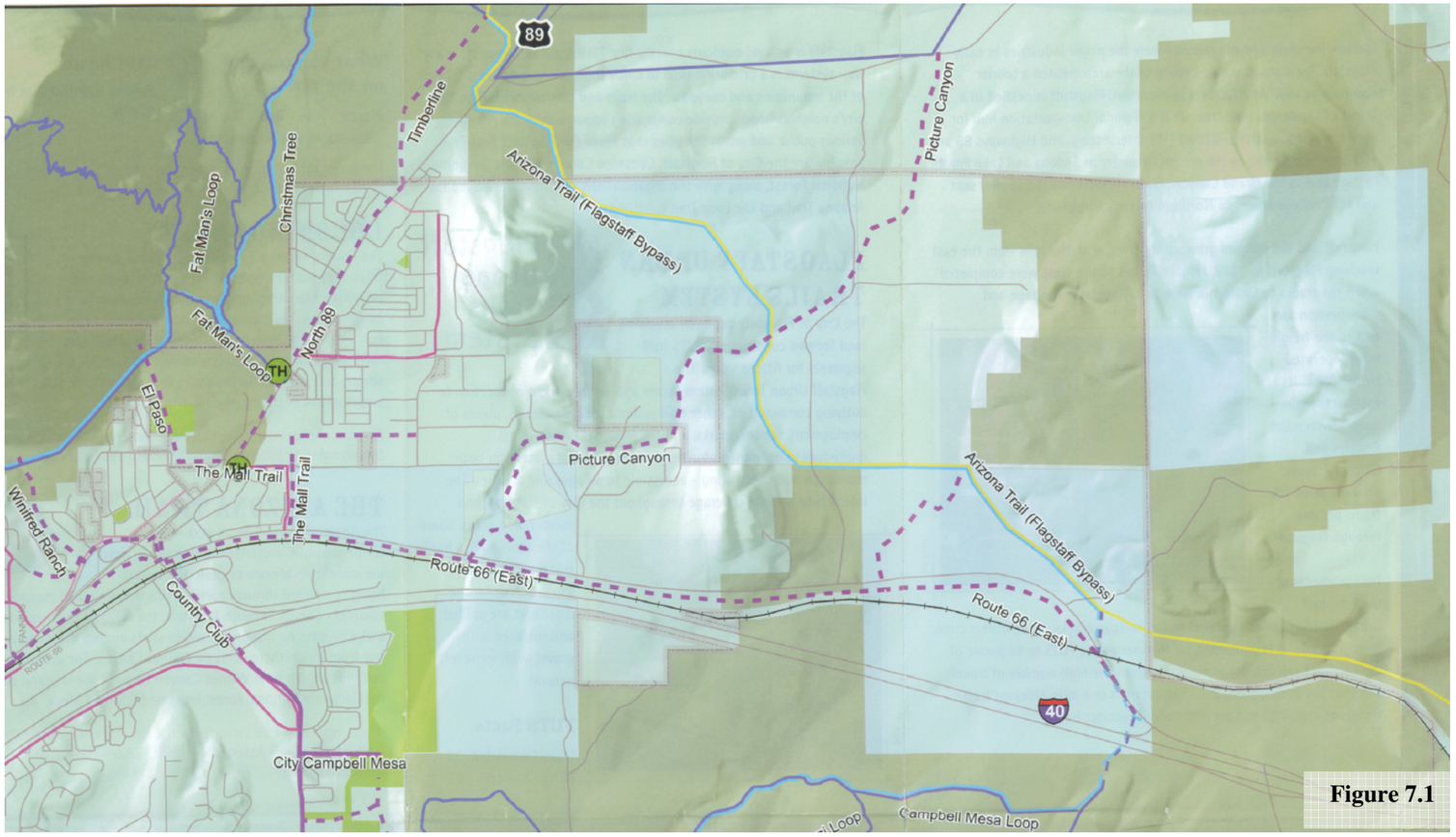


Figure 7.1

In the areas where the TW Rd Corridor lays next to the Coconino National Forest Service Lands, it may be desirable to place the path on Forest Service Lands. This appears logical in many cases as an existing path can be seen from the road and from the aerial mosaics used for the project plans. For example, from milepost 424.6, see the top half of sheet 6 of 12, through milepost 426.3, see the bottom half of sheet 7 of 12, it may be preferred to utilize the existing path on the Forest Service Lands. In some cases, utilizing the existing path on the Forest Service Lands would eliminate the need for additional right-of-way or retaining wall construction within the existing TW Rd Corridor.

The County may also wish to consider pathway construction at certain locations to compliment the existing adjacent pathway system. An example is a connection along Koch Field Rd, north some 1,500' to the existing path and sidewalk previously mentioned in *Section 7.1*.

7.3 Path Design

Pathways should be constructed for both pedestrians and horses but barriers need to be placed to prevent ATV's from using the pathways, see **Figure 7.2**. Aesthetically pleasing barriers can be placed at right of way entrances and at regular spaced intervals along the trail to allow pedestrian bike and horse passage but prevent ATV's from entering or continuing.

Some equestrian groups may request horse step thru gates at certain locations in the right of way fence. As with all barriers care must be taken to prevent injury to horses and riders and it is suggested that equestrian groups be consulted and involved in placement of all barriers.

7.4 Path Phasing

The Project Plans show the first phase, which would be approximately 4-1/4 mile long on the western end of TW-Road from US 89 to Slayton Ranch Road. This project could include the extension north on Koch Field Road to the existing trail and sidewalk system. The proposed Picture Canyon Trail would connect this initial proposed system to the existing Arizona Trail. This is logical because the west end of TW Rd is the most densely populated; thereby generating the highest volume of pedestrian and roadway activity.

The second phase would tie in to the first phase at Slayton Ranch Road and extend to the east with pathways extending north and south along residential collector roads. The second phase could be divided up into smaller segments as the need for roadway improvements moves from west to east and/or as funding is available for a path only project.

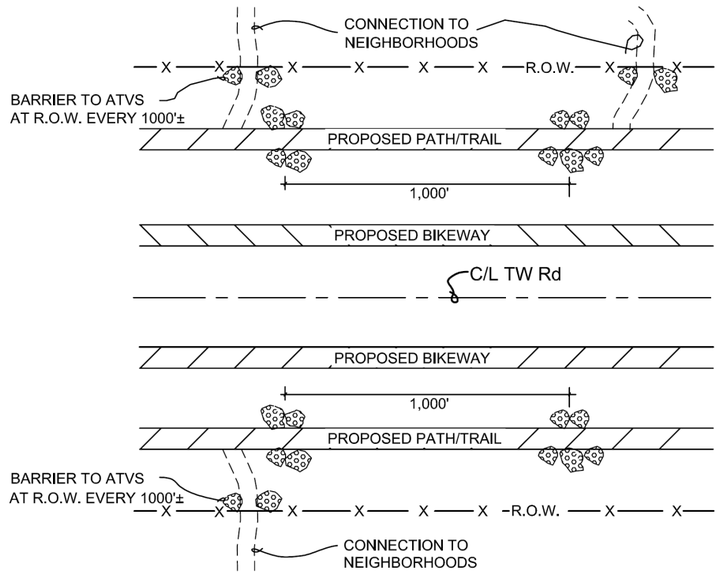


Figure 7.2

PROPOSED PATHWAY PLAN
NTS